Prepared By:

GM BluePlan ENGINEERING

City of Guelph

Norwich Street Bridge Class Environmental Assessment Project File (Schedule B)

GMBP File: 116046-1

DRAFT (March 2017)

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EXECUTIVE SUMMARY

TABLE OF CONTENTS

1. INTRODUCTION 1
2. MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PROCESS 3
3. PROBLEM / OPPORTUNITY STATEMENT 6
4. EXISTING CONDITIONS 6
4.1 Socio-Economic Environment 6
4.1.1 Land Use 6
4.1.2 Official Plans and Policies 7
4.2 Cultural Environment 7
4.2.1 Cultural Heritage 7
4.2.2 Archaeology 8
4.3 Natural Environment 9
4.3.1 Background Review 9
4.3.2 Trees and Vegetation 10
4.3.3 Wildlife Habitat 10
4.3.4 Aquatic Habitat 10
4.4 Technical Environment 11
4.4.1 Utilities 11
4.4.2 Structural 11
4.4.3 March 2002 – Bridge Evaluation Report 12
4.4.4 2015 – Safety Critical Report 12
4.4.5 September 2015 – Structural Inspection and Design Alternatives 13
4.4.6 Hydrology/Hydraulics 13
4.4.7 Transportation and Traffic 15
5. IMPACT AND EVALUATION OF ALTERNATIVE SOLUTIONS 15
5.1 Alternative Solutions 15
5.1.1 Alternative 1: Sympathetic Rehabilitation of the Existing Bridge 16
5.1.2 Alternative 2: Installation of a New Bridge Structure between the Existing Trusses 18
5.1.3 Alternative 3: Sympathetic Replacement of the Existing Bridge 19
5.1.4 Alternative 4: Bridge Removal (without Replacement) 20
5.1.5 Alternative 5: Do Nothing 20
5.2 Summary of Alternatives 20
5.3 Preliminary Costs 21
5.4 Assessment and Evaluation of Alternatives 22
5.4.1 Assessment of Alternatives 22
5.4.2 Evaluation of Alternatives 22
6. RECOMMENDED ALTERNATIVE 26

6.1 Description of Recommended Alternative 26
6.2 Environment Impacts and Mitigation Measures 26
6.2.1 Socio-Economic Environment Impacts and Mitigation 26
6.2.2 Cultural Environment Impacts and Mitigation 26
6.2.3 Natural Environment Impacts and Mitigation 26
6.2.4 Technical Environment Impacts and Mitigation 26

APPENDICES

APPENDIX A: CULTURAL HERITAGE EVALUATION & HERITAGE IMPACT ASSESSMENT

APPENDIX B: STAGE 1 ARCHAEOLOGICAL ASSESSMENT

APPENDIX C: SCOPED ENVIRONMENTAL IMPACT STUDY

APPENDIX D: RECENT STRUCTURAL INSPECTIONS

APPENDIX E: EXCERPTS FROM SPEED RIVER HEC-RAS MODEL

CITY OF GUELPH

NORWICH STREET BRIDGE CLASS ENVIRONMENTAL ASSESSMENT
PROJECT FILE (SCHEDULE B)

GMBP FILE: 116046-1

DRAFT (MARCH 2017)

1. INTRODUCTION

The City of Guelph (City) is evaluating alternatives to address the deteriorating condition of the Norwich Street bridge over the Speed River, located on the former Norwich Street between Cardigan Street and Arthur Street North. The Study Area is generally the section of the pedestrian path crossing the Speed River at this location, including the existing bridge. Refer to **Figure 1** for a location plan of the Study Area.

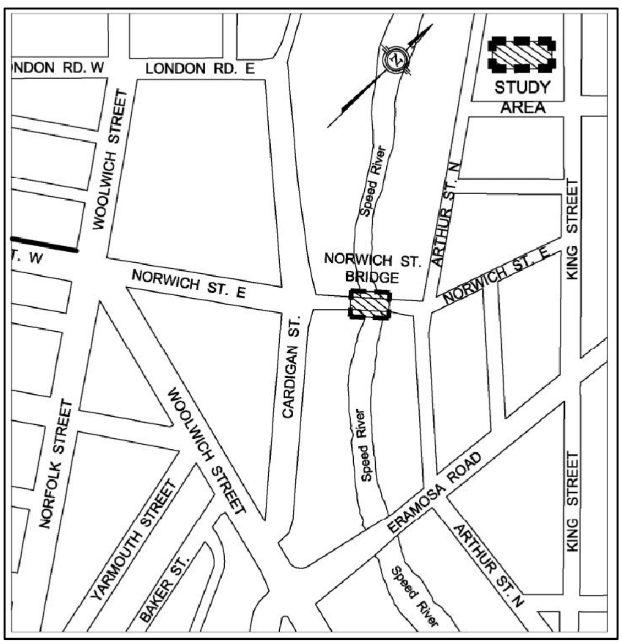


Figure 1: Study Area

The existing bridge is a half through Pratt truss (pony truss) bridge located approximately 70 m east of Cardigan Street on the former Norwich Street road allowance, and was built in 1882. It is constructed of a timber deck on riveted steel with a span of 17.0 m and a travelled width of 3.7 m. Refer to **Figure 2** for a photograph of the existing structure.

Figure 2: Photograph of Existing Norwich Street Bridge

The Norwich Street bridge was used as a vehicular bridge linking the east and west areas of what is now known as the Goldie Mill Neighbourhood. Historically, this crossing site facilitated the movement of materials across the Speed River serving the needs of nearby mills and foundries. This structure is the only surviving iron and steel truss bridge of the many that once existed in the City of Guelph. For these reasons, the City designated the entire steel and iron structure of the Norwich Street bridge, as well as the date plates, in 1998 (By-law 1998-15786). The bridge was closed to vehicle traffic in approximately 2003 following the recommendations of a bridge evaluation. It has since served as a pedestrian bridge for trails along the Speed River. We note that the date plate on the northwest side of the bridge is missing. A plaque describing the bridge is located on the north truss.

Prior to closing the bridge to vehicle traffic, a 5 tonne load limit was in place on the Norwich Street bridge. We have not completed any structural calculations on the load capacity of the existing structure; however, it can be reasonably assumed that the current load limit would be no more than 5 tonnes due to ongoing deterioration and no meaningful structural repairs having been completed since it was designated as a heritage structure in 1998. It is very likely that the current load limit for the structure would be less than 5 tonnes.

A steel pedestrian truss footbridge, known as the Norwich Street pedestrian bridge, is located south of the Norwich Street bridge. The superstructure of this bridge is independent of the Norwich Street bridge, and was not a part of the designation bestowed upon the Norwich Street bridge in 1998. This structure is currently closed to pedestrian traffic, and is not considered within the Study Area of this study; however, this footbridge supports an existing watermain and sanitary sewer. Ultimately, the removal of the footbridge is not considered within the scope of this study, but the preferred alternative will need to consider how the watermain and sanitary sewer are supported upon implementation.

The City has initiated a Schedule B Municipal Class Environmental Assessment (EA) study with the following key objectives:

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

The Purpose of this report (Project File) is to document the Schedule B Class EA process, including public consultation, the evaluation and assessment of alternatives against social, cultural, natural environment, technical and economic criteria, as well as the selection of the preferred solution.

2. MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PROCESS

Municipal infrastructure projects are subject to the Ontario Environmental Assessment Act (EA Act). The Class Environmental Assessment is an approved self-assessment process under the EA Act for a specific group or "class" of projects. Projects are considered approved subject to compliance with an approved Class EA process. The Municipal Class EA (Municipal Engineers Association October 2000, as amended in 2007, 2011 & 2015) applies to municipal infrastructure projects including roads, water and wastewater.

The Municipal Class EA outlines a comprehensive planning process (illustrated in **Figure 3**) that provides a rational approach to consider the environmental and technical advantages and disadvantages of alternatives and their trade-offs in order to determine a preferred alternative for addressing the problem (or opportunity), as well as consultation with agencies, directly affected stakeholders and the public throughout the process. The key principles of successful environmental assessment planning include:

- Consultation;
- Consideration of a reasonable range of alternatives;
- Consideration of effects on natural, social, cultural, and economic environments and technical components;
- Systematic evaluation;
- Clear documentation; and
- Traceable decision making.

The classification of projects and activities under the Municipal Class EA is as follows:

Schedule A – Includes normal or emergency operational and maintenance activities, which are limited in scale and have minimal adverse environmental effects. These undertakings are pre-approved and the proponent can proceed without further assessment and approval.

Schedule A+ – Introduced in 2007, these minor projects are pre-approved. The public is to be advised prior to the implementation of the project.

Schedule B – Includes projects which have the potential for adverse environmental effects. This includes improvements to, and minor expansions of existing facilities. These projects are approved subject to a screening process which includes consulting with stakeholders who may be directly affected and relevant review agencies.

Schedule C – Includes the construction of new facilities and major expansions to existing facilities. These undertakings have the potential for significant environmental effects and must proceed under the planning and documentation procedures outlined in the Municipal Class EA document.

This study is proceeding as a Schedule 'B' process, in accordance with the requirements of the Municipal Class EA process, which includes Phases 1 and 2, depicted on **Figure 3**:

- Phase 1 consists of identifying the problem or opportunity.
- Phase 2 involves identifying reasonable alternatives to the problem or opportunity, compiling an inventory on the natural, social and economic environment, evaluating each alternative and recommending a preferred alternative that will address the problem, and provide any measures necessary to mitigate potential environmental impacts. Public and agency consultation is required at this stage before the preferred solution is selected to ensure all possible impacts are identified, and assessed as part of the evaluation process.

Once the Preferred Solution is selected and confirmed by Council, the final Project File is made available for public review during a 30-calendar day period. A Notice of Completion is submitted to review agencies and the public at this time.

If concerns are raised during the 30 calendar-day review period that cannot be resolved through discussions with the Municipality, then members of the public, interested groups or technical agencies may request the Minister of the Environment and Climate Change (MOECC) to issue a Part II Order (i.e. bump-up) for the project, thereby requiring an elevated scope of study. A Part II Order request requires submission of a written request to the Minister, prior to the end of the 30-calendar day review period, outlining the unresolved issue and requesting the Minister to review the matter.

Part II Order requests are submitted to:

The Honourable Glen Murray
Minister of the Environment and Climate Change
77 Wellesley St. W.
Toronto, Ontario M7A 2T5
Fax: 416-314-8452
gmurray.mpp@liberal.ola.org

Copies of the request must also be sent to the Director of the Environmental Approvals Branch at the MOECC at the address below:

Attn: Ms. Agatha Garcia-Wright
Director, Environmental Approvals Branch
Ministry of the Environment and Climate Change
Floor 12A, 2 St. Clair Avenue W
Toronto, ON M4V 1L5
EAASIBgen@ontario.ca

For further information regarding Part II Order requests and process, please go to:

https://www.ontario.ca/environment-and-energy/class-environmental-assessments-part-ii-order

The decision whether a Part II Order (i.e. bump-up) is appropriate or necessary rests with the Minister. If no Part II Order requests are outstanding by the end of the 30-calendar day review period, the project is considered to have met the requirements of the Class EA, and the proponent may proceed to design and construct the project subject to resolving any commitments documented in the Project File during the subsequent design phases and obtaining any other outstanding environmental approvals.

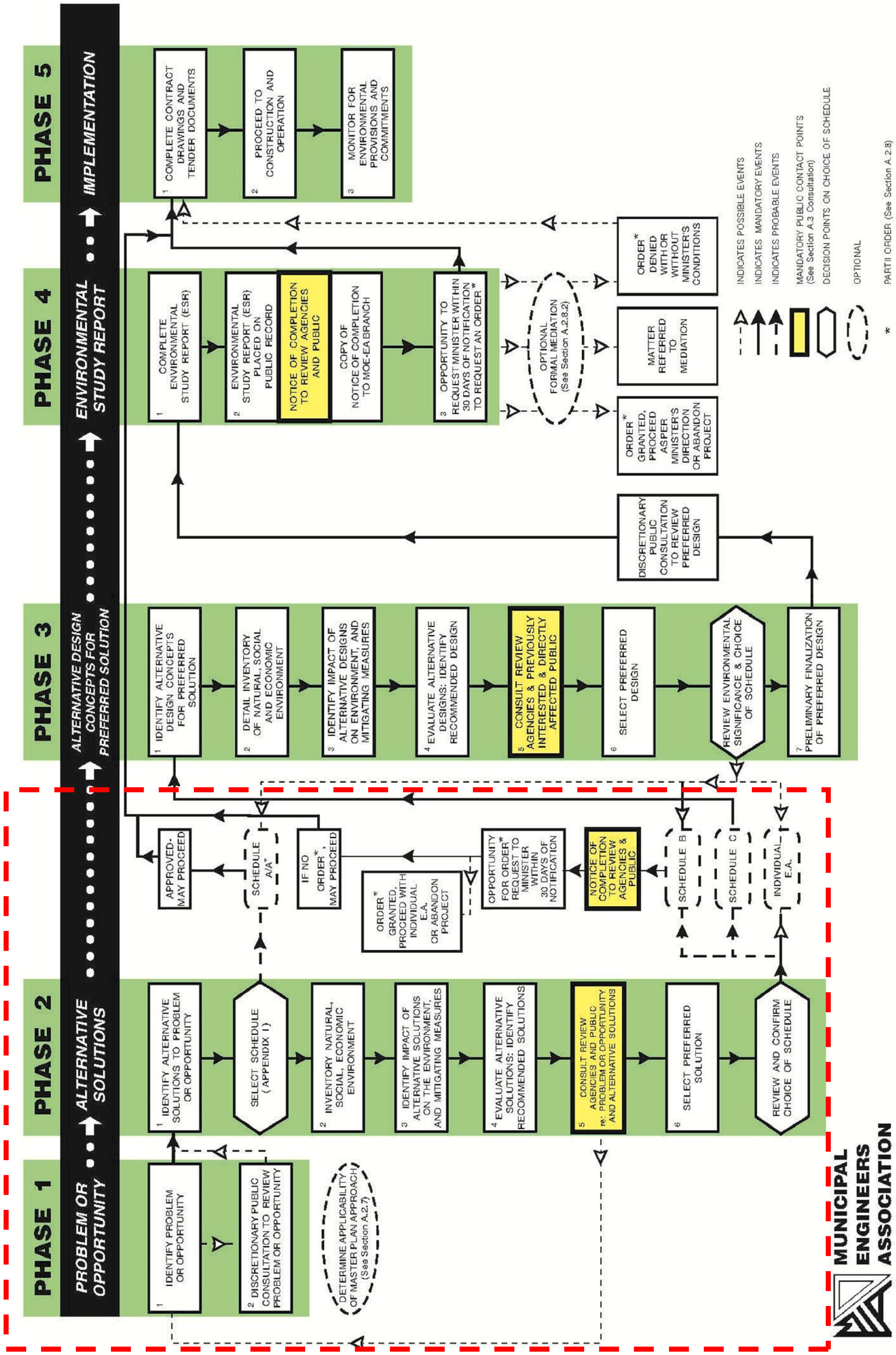
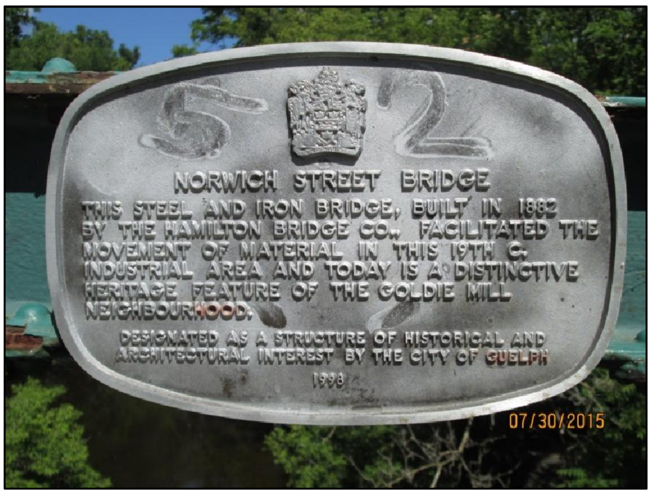


Figure 3: Municipal Class Environmental Assessment Process

3. PROBLEM / OPPORTUNITY STATEMENT

Structural inspections have identified the need for repairs or replacement of the Norwich Bridge due to its poor condition. The bridge was constructed in 1882 by the Hamilton Bridge Company, and is an historical pony truss bridge located approximately 70 m east of Cardigan Street on the former Norwich Street road allowance. It has a span of approximately 17 m and a travelled width of 3.7 m. This structure was used for vehicle traffic until approximately 1998, when it was limited to pedestrian traffic only. The bridge, including its date plates, is designated as a heritage structure under the Ontario Heritage Act, in accordance with By-law Number (1998)-15786. Additionally, a sanitary sewer and water main are suspended from the closed pedestrian bridge adjacent to the Norwich Street bridge.



Problems identified with the Norwich Street bridge include:

- The existing bridge is 134 years-old and is in poor condition;
- There are deficiencies and issues including: severe corrosion, loss of section on the floor beams and pin connections, warping of the top chord of the trusses, severe sections of delamination and disintegration of the abutments and wing walls, and the possible undermining of the northwest abutment footing; and,
- Support of the existing sanitary and water main crossing the Speed River needs to be addressed.

The City of Guelph plans to explore how to best maintain this heritage and utility crossing while balancing social, cultural, natural environment, technical and economic responsibilities.

4. EXISTING CONDITIONS

4.1 Socio-Economic Environment

4.1.1 Land Use

The Study Area is set within an urban landscape on the edge of the City of Guelph's downtown core. Adjacent landscapes include parkland, multi-use trails, an active rail corridor, the Speed River, attached and detached residences and high-rise apartment buildings.

The Speed River is a prominent watercourse through the City of Guelph and within the Grand River Conservation Authority's (GRCA) watershed. The watercourse at the Study Area is channelized by large concrete retaining walls on either bank of the river. Upstream of the site, the banks of the watercourse are subject to erosion issues. The Speed River is subject to a cool-water timing window for in-water works (works not permitted from March 15 to June 30), and its narrow floodplain is characterized by wooded vegetation within urban parkland upstream and downstream of the subject area.

4.1.2 Official Plans and Policies

The City of Guelph Official Plan is used to guide land use and activities by establishing goals, objectives and policies while considering the greater Guelph community. This includes the social, economic and natural environments. The following summarizes a review of Guelph's Official Plan:

- The City of Guelph will encourage and develop a system of publicly accessible parkland, open space and trails.
- The existing bridge is considered essential transportation infrastructure.
- The existing bridge is located within a Significant Natural Area and is within the Regulatory Floodplain for the One Zone Floodplain. No development is permitted within the One Zone Floodplain; however, this area may be used for outdoor recreation and open space conservation areas.
- Any permitted infrastructure must consider the Natural Heritage System and minimize impact, where feasible.
- Any construction within or across surface water features or fish habitat must occur during the appropriate Ministry of Natural Resources and Forestry (MNRF) timing windows, and best management practices should be employed during construction.
- Opportunities to restore permanent and intermittent stream and fish habitat are encouraged.

We note that the Norwich Bridge is not identified as a pedestrian or cyclist crossing in the following documents:

- City of Guelph Official Plan maps
- City of Guelph Cycling Master Plan Schedule 1: Proposed Cycling Network map
- City of Guelph City Wide Trail Master Plan Tail Network

4.2 Cultural Environment

4.2.1 Cultural Heritage

The Norwich Street bridge is designated under Part IV of the Ontario Heritage Act under the City's By-law Number (1998)-15786. A Cultural Heritage Evaluation and Heritage Impact Assessment was completed by Archaeological Services Inc. (ASI) to establish the cultural heritage significance of the Norwich Street bridge and assess impacts of the proposed undertaking in consideration of its determined heritage value. The complete report is provided in **Appendix A**. The heritage significance of the structure is due to the following:

- Its design, associated and contextual value given the relative rarity of comparable structures in the City.
- The associations with the Hamilton Bridge Company and the industrial history of the City.
- Its continued association with the settlement, growth and economic development in this part of the City.

As part of the assessment of impacts to the heritage value, the following nine options were considered based on the *Ontario Heritage Bridge Program* (1991). Where applicable, the Alternatives found in **Section 5.1** of this report are in brackets).

1. 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 **(within Alternative 1).**
2. Retention of existing bridge with no major modifications undertaken.
3. Retention of existing bridge with sympathetic modification **(within Alternative 2).**
4. Retention of existing bridge with sympathetically designed new structure in proximity.
5. Retention of existing bridge no longer in use for vehicle purposes but adapted for pedestrian walkways, cycle paths, scenic viewing, etc.
6. Relocation of bridge to appropriate new site for continued use or adaptive re-use **(within Alternatives 3).**
7. Retention of bridge as heritage monument for viewing purposes only **(within 3).**

8. Replacement/removal of existing bridge with salvage elements/members of heritage bridge for incorporation into new structure or for future conservation work or displays **(within Alternative 3)**
9. Replacement/removal of existing bridge with full recording, documentation and the heritage bridge **(within Alternative 3)**

Following the evaluation of the options above, Option 3 is preferred from a heritage resource perspective. **This corresponds to Alternative 2 in Section 5.1.** This alternative has no impact given that alterations would be sympathetic to heritage attributes. This would include the construction of a structure within the trusses of the Norwich Street Bridge, removing the load bearing strain off the current bridge and thus extending its lifespan. The new structure should be designed to cast minimal shadows on the trusses of the heritage structure.

Based upon on the potential impacts on the heritage resource, it was determined that ‘Sympathetic Restoration with new Bridge Structure’ generally corresponds to Alternative 3 in Table 2: Retention of existing bridge with sympathetic modification.

4.2.2 Archaeology

Following the Standards and Guidelines for Consultant Archaeologists, administered by the Ministry of Tourism, Culvert and Sport (MTCS), a Stage 1 Archeological Assessment was completed by ASI. This assessment includes background research into the study area and is used to determine the archaeological site potential. The complete report is provided in **Appendix B**. The assessment generally identified the following:

- “The property inspection determined that parts of the Study Area have been subjected to deep soil disturbance events from the construction of the existing bridge, right-of-way, and sewer infrastructure, and … do not possess archaeological potential … (Figure 8: areas highlighted in yellow). These areas do not require further assessment.” (Section 3.2, Paragraph 1)
- “Some lands within the Study Area adjacent to the river are sloped in excess of 20 degrees, and … do not possess archaeological potential… (Figure 8: areas highlighted in purple). These areas do not require further assessment.” (Section 3.2, Paragraph 1)
- “The remainder of the Study Area retains archaeological potential … (Figure 8: areas highlighted in green). These areas will require Stage 2 archaeological assessment…” (Section 3.2, Paragraph 2)
- “Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands.” (Section 4.0, bullet 3)

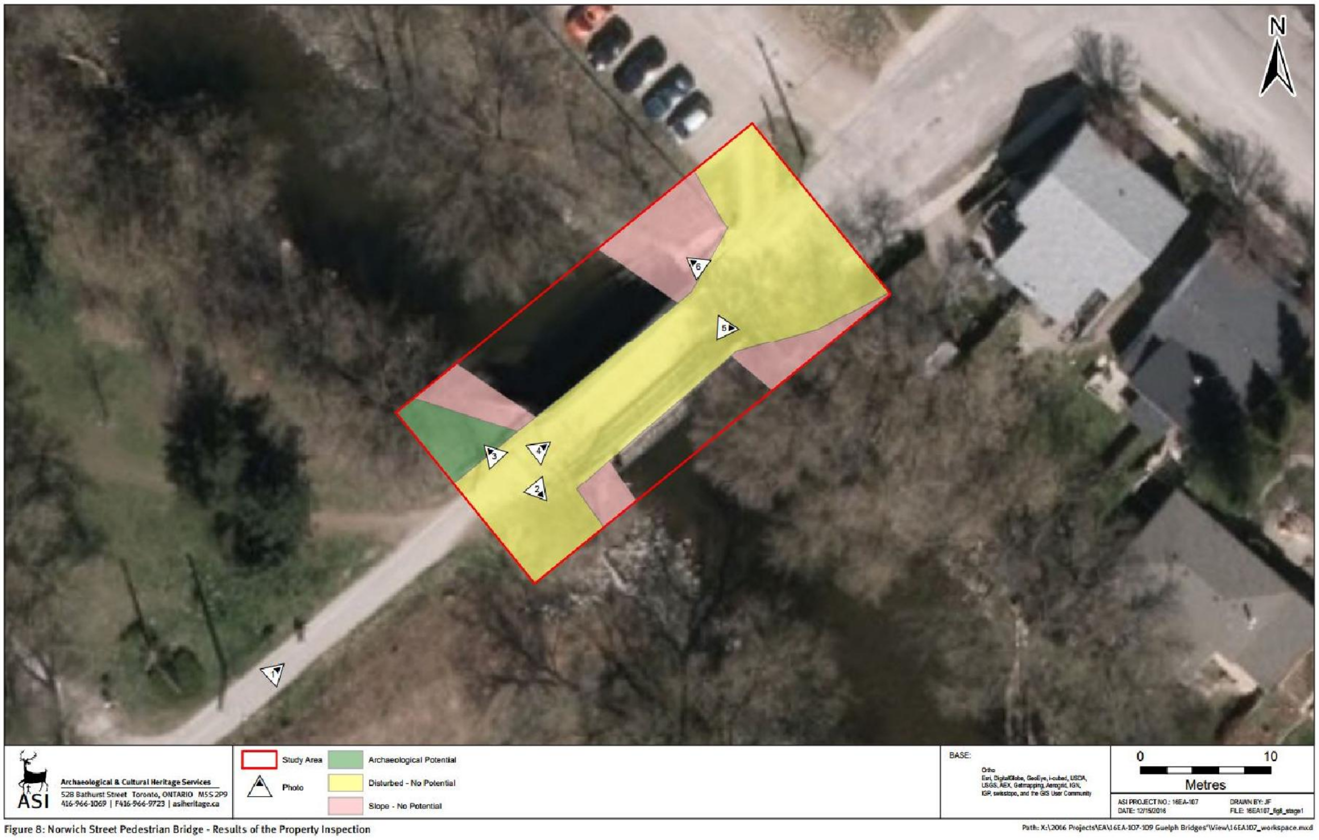


Figure 4 Results of Property Inspection
(ASI Stage 1 Archaeological Assessment Report - Figure 8)

Recommendations from the Stage 1 Archaeological Assessment report included that if the area outside the slope at the south west corner of the existing bridge (green area in **Figure 4** be impacted by the selected preferred alternative(s), a Stage 2 assessment would be required. If Alternative 3 (full replacement) is selected as the preferred alternative, a Stage 2 Archaeological Assessment would be required.

4.3 Natural Environment

Aboud & Associates Inc. (Aboud) completed a review of the natural heritage of the Study Area as part of their scoped Environmental Impact Study (EIS). The full study is provided in **Appendix C**, and is summarized as follows.

4.3.1 Background Review

The following is a summary of the background review completed as part of the EIS report:

- Investigation in the Natural Heritage Information Centre (NHIC) identified three provincial Species at Risk (SAR) protected under the Endangered Species Act, 2007 (ESA) and one other species identified as rare within approximately 1 km of the Study Area.
- No SAR occurrence records were provided by the MNRF for this site based on a request for information response dated July 7, 2016.
- No habitat for SAR birds was present in the Study Area based on a review of the 2001-2005 Ontario Breeding Bird Atlas.
- A review of the Ontario Reptile and Amphibian Atlas identified 28 species that are known to occur within a 10 km x 10 km square area containing the Study Area, including four SAR under the ESA. Nesting or overwintering habitat was not identified in the Study Area; however, overwintering habitat may be present in

the watercourse for Common Snapping Turtle. Twelve reptile/amphibian species considered Locally Significant by the City of Guelph and seventeen species considered Significant Species in Wellington County were noted for the Study Area.
- A review of the Atlas of the Mammals of Ontario (1994) identified twenty-nine species that are known to occur within 10 km of the Study Area, including one SAR. Two mammal species are considered Locally Significant by the City of Guelph, and two are considered Significant Species by the County of Wellington.

4.3.2 Trees and Vegetation

The following is a summary of the trees and vegetation review completed as part of the EIS:

- Four ecological communities were identified within the Study Area including Dry Fresh Mixed Meadow Ecosite (MEMM3) in recently disturbed areas, Fresh Manitoba Maple Deciduous Forest (FODM4-5) along the open areas within the floodplain and adjacent to the river, Parkland (CGL_2) within the park and trails on the west side of the river and Shallow Aquatic (SA) within the river.
- None of the ecological communities are listed as provincially rare communities.
- A botanical field inventory was completed, during which 43 species were identified (21 native and 22 exotic species).
- One native species inventoried was ranted as Imperiled (S2) in Ontario (Cup Plant, *Silphium perforliatum*); however, the specimen in the Study Area is of the variety grown in gardens and should not be considered rare or protected within Ontario.
- A tree inventory was completed, listing Manitoba Maple (71%), Black Walnut (13%), White Spruce (8%), American Elm (4%) and Austrian Pine (4%) as the species within the Study Area

4.3.3 Wildlife Habitat

The following is a summary of the wildlife habitat review completed as part of the EIS:

- Of the species observed incidentally during the site review, none are listed as Special Concern both provincially and federally.
- Two areas of Significant Wildlife Habitat were identified within the Study Area: Waterfowl Stopover and Staging (Aquatic) and Turtle Wintering Area.

4.3.4 Aquatic Habitat

The following is a summary of the aquatic habitat review completed as part of the EIS:

- During the aquatic assessment, a number of small, unidentified fish were observed within the watercourse throughout the Study Area.
- The watercourse within the Study Area is of moderate habitat quality for fish, with significant shaded sections reducing thermal impacts.
- Water control structures upstream and downstream create full or partial barriers, limiting fish movement.
- The watercourse is classified as a coolwater system, meaning that in-water works are not permitted between March 15 and June 30.

Natural Environment Crossing Alternative Analyses

- Alternative 1 and 2 would have the lowest impact based on the limited number of trees that would need to be trimmed to facilitate crane usage to rehabilitate the existing structure and minimal in water work to repair the substructure. Alternative 1 and 2 are the preferred alternatives from a Natural Heritage perspective.
- Alternatives 3 and 4 would presumably require more work within the river to remove and rebuild the west abutment. However, as the west abutment is within the current high-water mark, the long term benefits of reconstructing the west abutment outside of the high water mark, removing the restriction on the water course, may balance with the shorter term impacts.

4.4 Technical Environment

4.4.1 Utilities

The utilities in the Study Area will need to be considered as they will impact the construction method available. Based on our investigation, the following are utilities that may impact construction:

- Watermain and sanitary sewer pipes exist just to the south of the existing bridge and are currently hung from the now closed pedestrian bridge.
- Utility poles carrying aerial utilities are immediately to the north of the existing heritage bridge.
    - The primary hydro lines (three at the top of the poles) are 13,860 volt lines. The next line down is the system neutral. All four (4) lines require any machinery and labourers to remain 3 metres (10 feet) away at all times.
    - The next line down the poles we believe are street lighting which would likely require a minimum of 1 metre (3 feet) clearance. Guelph Hydro could not confirm this at the time of the EA.
    - The lowest line is believed to be Rogers Cable.

The power feed to this area comes through four different transformer stations and could potentially be de-energized to allow for closer proximity to the power lines to allow for the use of cranes. However, based on the system configuration and other construction works at the time of bridge construction, the power lines at the bridge may not be able to be de-energized to allow for safe completion of construction activities. Coordination with Guelph Hydro will be required during detailed design through to construction completion.

While utility locates for design purposes were acquired during this EA study, the detailed design team should confirm all utilities in the area before construction.

4.4.2 Structural

The following structural deficiencies were noted in the recent visual inspections of the Norwich Street bridge:

- The deck is showing signs of moderate rotting and rutting, creating and uneven surface that could soon pose tripping hazards to pedestrians.
- Several of the riveted steel members show signs of corrosion and “pack rusting”, which is causing scalloping or warping of the top plate of the top chords of the trusses.
- The expansion joints are severely corroded, and were previously encased in concrete due to their deteriorated condition. Due to the concrete encasement, the bridge is no longer able to move longitudinally to accommodate thermal expansion and contraction.
- Scour and potential undermining of the northwest footing was observed.
- Severe corrosion and loss of section was noted on the steel floor beams.
- The pin connections are severely corroded, which may be concealing more serious defects in the pins themselves as well as the eye-bars that connect to the pins.

Excerpts from these reports are provided in the sections below, with the full reports provided in **Appendix D.**

Structural Loading Considerations:

- According to the CAN/CSA S6-14 Standard (Canadian Highway Bridge Design Code) the live load to be applied to pedestrian bridges would cause a pedestrian load in excess of 25 tonnes over the current span.
- It was estimated by Triton Engineering Services Limited (Triton) that the original design of the Norwich Street Bridge in 1882 was for approximately 9 tonnes. Based on the condition of the structure in 2002, Triton determined a 2002 vehicular load capacity of approximately 4 tonnes. This does not account for further deterioration of the bridge 15 years later or repairs completed in 2003.
- While pedestrian loads and a vehicular loads are not directly relatable due to various design considerations (location of truck wheels versus pedestrian uniform loads, vehicle impact factors, etc.), the existing structure as

originally designed would not likely be theoretically able to support current code pedestrian loads. Considering the current structure condition, if a full current code pedestrian design load were to be applied to the structure it would exceed the theoretical capacity of the bridge.

- Based on the above, it will be extremely difficult and expensive to rehabilitate the existing bridge to be able to support current day code loading.
- A load posting to limit the number of patrons on the bridge could be added, however, load postings are often ineffective. Enforcement of a load posting would be also be difficult.

4.4.3 March 2002 – Bridge Evaluation Report

Triton Engineering Services Limited (Triton) of Orangeville completed a Bridge Evaluation Report for the Norwich Street Bridge in March 2002. Excerpts from this report include:

- "The bridge has been posted for a restricted load limit of 5 tonnes, equivalent to a light delivery truck, since 1976, when the bridge was under the jurisdiction of the MTO."
- "It is estimated that the bridge was originally designed to carry 9 tonnes, and 120 years later, severe corrosion has reduced the safe carrying capacity to a weary 4 tonnes at best."
- "There was a partial collapse of the bridge in 1948 reportedly caused by a weakening of the west abutment by flood waters. The west abutment and wingwalls were subsequently reconstructed."
- "In 1994, the vehicle bridge required significant strengthening of the compression chords near the end posts and reconstruction of the tension tie connections to maintain a minimum load carry capacity."
- Based on a November 2000 detailed visual inspection by Triton, "In 2001 several knee braces were replaced to improve the stability of the trusses and timber curbs were added for protection of the trusses."
- "This type of bridge structure has very little redundancy in terms of load carrying capacity and failure of a truss component under vehicular load would likely result in a completed collapse of the structure. Compounding the problem is that steel components fabricated in the 1800's are considered to be very brittle in nature and catastrophic failure could occur with little or no advance warning, possibly resulting in severe injury or death."
- "Preservation of the bridge for heritage reasons will also be very costly. Preservation for an indefinite period will require replacement/strengthen of some components, partial dismantling and reconstruction of the bridge, and application of corrosion inhibiting coatings."
- "Environmental regulations related to the removal and application of protective coatings add significant costs to the long term preservation of the structure."
- To reduce long term costs and to preserve the bridge, in light of its heritage designation, it is recommended that the existing bridge be dismantled, restored in a shop environment, and reassembled in a benign environment, such as a park, where it would not be subject to road salts or aggressive chemicals."

4.4.4 2015 – Safety Critical Report

Engineered Management Systems Inc. (EMSI) of Mississauga completed an Ontario Structure Inspection Manual (OSIM) inspection in 2015 which resulted in a report titled "Safety Critical Report 002 – 2015". Excerpts from this report include:

- "We noted severe to very severe corrosion at several connections located along the bottom chords. We estimate that the loss of section at these connections is 50-60 % impacting the ends of diagonals, bottom chords and verticals. The floor beams and some bolts also exhibit severe to very severe corrosion."
- "The bottom chords at the end of the truss (bearing area) are not completely visible and we cannot estimate the extent of deterioration; however, we noted severe to very severe corrosion at all four ends."
- "A structure evaluation and remedial measures are immediately required (failure of even one connection along the bottom chord may trigger a sudden partial or total collapse of the entire truss)."
- "Coating deterioration has resulted in severe deterioration of structural steel and corrosion will accelerate (some components are already beyond repair)."

- "The condition of the entire structure should be monitored by maintenance crews and any abnormal behaviour should be reported to the City technical staff."

4.4.5 September 2015 – Structural Inspection and Design Alternatives

Following the 2015 EMSI Safety Critical Report, the City procured a report from GM BluePlan Engineering Ltd. (GMBP) titled "Norwich Street Pedestrian Bridges, Structural Inspection and Design Alternatives (Structures 00009-1 and 00009-2)" dated September 18, 2015. Excerpts from this report for the historical Pony Truss bridge (Structure 00009-1) include:

- "Major deficiencies with the structure included severe corrosion and loss of section on the floor beams, severe corrosion of identified pin connections, and warping of the top plate of the top chord. The abutments and wingwalls have severely delaminated sections with disintegration, and the northwest footing may be undermined."
- "The pin connections and floor beams at the middle bays of the bridge (south truss) are the area of greatest concern The amount of corrosion is difficult to assess based on the visual inspection completed; however, there were several areas of severe corrosion with loss of section noted with the top flange of one floor beam noted to be completely missing in one area."
- "…however, immediate and sudden failure may be possible in these heavily corroded areas. It is recommended that the City take action immediately as outlined in the following sections."
- The report describes various six (6) rehabilitation alternatives including: Historic Restoration, Sympathetic Restoration, Sympathetic Restoration with a new Bridge Deck, Sympathetic Restoration with a new Bridge Structure, Replacement, and Removal.
- "Based on the deteriorated condition of the structure, we believe it would be in the City's best interest to pursue options that involve constructing a stand-alone bridge structure while maintaining the historic trusses with minor restoration works (sympathetic restoration with new bridge deck or sympathetic restoration with new bridge structure options)."

4.4.6 Hydrology/Hydraulics

A HEC-RAS model of the Speed River from the Guelph Lakes Dam to Gordon Street was obtained by GMBP from the GRCA. This model was last updated in August 2016 to reflect additional topographic data obtained downstream of the Norwich Street bridge (filename: "Speed R4 August2016"). A brief hydrologic and hydraulic review of the existing bridge structure was completed to provide water surface elevation levels at the bridge under various design flow conditions. It should be noted that GMBP did not complete a thorough review of the model to verify hydrologic parameters, cross section data or other aspects of the model.

Pre-consultation discussions with staff from the GRCA occurred in 2016 regarding works to the bridge. It was noted during the discussions that any changes to the existing Norwich Street bridge should ensure that there is no increase in the upstream or downstream water levels after the bridge work (if any) is completed as compared to existing conditions.

There are very few guidelines available that provide criteria for hydraulic performance of pedestrian bridges. As a reference, we have considered typical design criteria for roadway bridges and culverts as a comparison, as these structures often convey pedestrian and cyclist traffic in addition to vehicle traffic. The MTO Highway Drainage Design Standards (2008) WC-1 Design Flows (Bridges and Culverts) recommends that bridges with spans greater than 6.0 m, serving local access roads, are be designed to convey the 25 Year design flow and have consideration for the "Regional Flood Flow" for high flow conditions.

Hydrology

Flow rates provided in the HEC-RAS model are provided in **Table 1**.

Table 1: Peak Flow Rates for Study Area

Design Storm	Flow Rate (m^3/s)
2 Year	81.9
5 Year	114.0
10 Year	134.0
20 Year	155.0
50 Year	181.0
100 Year	200.0
Regional – Original	512.0
Regional – GRHS	480.0

Hydraulic Analysis

As previously noted, the reference criteria for the bridge include the following:

- There is to be no increase in the upstream or downstream water elevations under all storm events following any works to the structure.
- The bridge should safely convey, at a minimum, the flow generated during a 25 Year design storm event.

The plan "ERI 2016 Update" was run to determine the flood elevations at River Sta. 25100.5 BR U Norwich St. The results of the model are provided in **Table 2** below.

Table 2: Results of the HEC-RAS Model at River Sta. 25100.5 BR U Norwich St

Design Storm	Water Surface Elevation under Existing Conditions (m)
2 Year	317.25
5 Year	317.70
10 Year	317.97
20 Year	318.21
50 Year	318.82
100 Year	318.82
Regional – Original	319.65
Regional – GRHS	319.77

The geometry file of the HEC-RAS model provides a soffit elevation for the Norwich Street bridge of 318.82 m. As shown in **Table 2** above, the existing bridge theoretically has capacity to convey the 25, 50 and 100 Year design flow events without overtopping; however, under a Regional Flow condition, the road would theoretically be overtopped. Based on the results of the HEC-RAS model, the existing bridge is sized to convey a 100 Year design flow event, meaning that it is sufficiently sized to meet the minimum design standard for a bridge on a local road previously referenced. It should be noted that the Norwich Street bridge is modelled as a solid bridge in HEC-RAS, and does not allow flow to pass through the bridge structure. The existing truss bridge is an “open” bridge type, which would allow water to pass through once the road has overtopped the top of deck. Therefore, the results provided above are conservative once the water surfaces reaches the deck elevation of 319.30 m. Excerpts from the HEC-RAS model are provided in **Appendix E**.

As the existing bridge abutments are retaining walls that extend upstream and downstream of the bridge, any proposed works to the Norwich Street bridge will not likely impact the characteristics of the crossing below the invert of the existing bridge.

Summary and Recommendations

Based on the above modelling and analysis, the following summarizes the results and recommendations of the above.

- The existing bridge is sufficiently sized to convey up to the 100 Year design flow.
- Water overtops the existing bridge during the Regional Flow.
- The cross-sectional flow area between the existing river bed and soffit elevation of the existing bridge should be maintained as part of any proposed works.
- The “open” bridge style should be maintained as part of any proposed works
- There are not anticipated to be any measurable changes in flood elevations or flow characteristics provided the above criteria are met.
- Should Alternative 3 be selected as the preferred alternative and the west abutment be moved west outside of the high water mark, downstream flood implications would need to be reviewed.

4.4.7 Transportation and Traffic

The Norwich Street bridge is a key pedestrian and cyclist link for the Goldie Mill Neighbourhood and Downtown. The bridge also provides connection for the neighbourhood to the Downtown Trail, and allows for a safe crossing of the Speed River away from vehicle traffic. Since the bridge was converted to strictly pedestrian and cyclist use, Norwich Street has been reconstructed west of the bridge so that the roadway dead ends at Cardigan Street. As previously mentioned, the City does not have any plans to reconstruct Norwich Street so that vehicle traffic can use the Norwich Street bridge.

Traffic data provided on the 2015 OSIM Inspection Report completed by Engineered Management Systems Inc. indicates that the Annual Average Daily Traffic (AADT) to be 200 users per day. It is estimated that this figure may be left over from when the bridge was open to vehicle traffic, as the City does not keep pedestrian and cyclist traffic count data and field observations by GMBP during site visits indicate that the daily usage by pedestrians and cyclists is much higher than this amount. Therefore, the bridge appears to be relatively well used and is a vital pedestrian crossing.

5. IMPACT AND EVALUATION OF ALTERNATIVE SOLUTIONS

5.1 Alternative Solutions

The alternative solutions represent different approaches or strategies to address the needs of the project, taking into consideration the all aspects of the environment. Under the provisions of the Municipal Class EA process, all reasonable alternative solutions require consideration to ensure that there is adequate justification to proceed with the improvements and that the need for the project is clearly demonstrated. The alternative solutions are assessed against their ability to reasonably address the identified problems and opportunities.

The City has already closed the Norwich Street bridge to vehicular traffic, and has implemented a trial network around this structure. The City does not desire to re-open this crossing to vehicle traffic and based on public feedback the public overwhelmingly support this view. Therefore, reopening the crossing to vehicular traffic will not be considered within this EA study.

The alternative solutions being considered are:

- Alternative 1: Sympathetic Rehabilitation of the Existing Bridge
- Alternative 2: Installation of a New Bridge Structure between the Existing Trusses
- Alternative 3: Sympathetic Replacement of the Existing Bridge
- Alternative 4: Bridge Removal (without Replacement)
- Alternative 5: Do Nothing

This section reviews the alternatives considered, provides preliminary costs for the alternatives and summarizes the general advantages and disadvantages associated with each alternative.

For all of the alternatives carried forward, there will need to be consideration given to a permanent support structure for the watermain and sanitary sewer pipes located south of the existing bridge and currently supported by the closed pedestrian bridge. As this work is required regardless of the alternative selected, it has not been discussed in greater detail within this section.

Additionally, the abutments and retaining walls are in need of repairs or replacement. Depending on the alternative below, there are two (2) possible avenues to address the deteriorated substructure. The options and generic scope of work are as follows:

Replacement of substructure:

- superstructure to be removed
- abutments, footings and close proximity retaining walls to be removed
- construct new footings, abutments and retaining walls
- install new superstructure

Rehabilitation of substructure:

- underpinning of west abutment to repair scour/undermining at upstream end
- localized concrete removal to sound concrete and repair
- localized removal and repair to northwest wingwall

Advantages and disadvantages of each option are described in associated with in the alternatives in the sections below.

5.1.1 Alternative 1: Sympathetic Rehabilitation of the Existing Bridge

Based on the visual structural review completed by GMBP in 2015, a significant rehabilitation effort would be required to repair this structure. Although the bridge once carried vehicle traffic, there are several key structural concerns that would need to be addressed as part of a rehabilitation project to maintain this structure as a pedestrian crossing.

As the steel trusses themselves are designated under the Ontario Heritage Act (2005 as amended), any repairs to the structural steel elements would need to consider the aesthetics of the repairs. Bolts and welding have replaced riveted construction as the preferred construction techniques due to manufacturing consistency, strength, speed and labour required during installation. Restoration using rivets to maintain the same aesthetics as the existing structure would present the same difficulties in planning and executing the work as present with bolting or welding, with the added challenge of using a construction technique that is no longer widely used in bridge and building construction. It is believed that the added costs for a riveted steel rehabilitation project are not warranted to mitigate the nominal change in appearance of the bridge. Therefore, Rehabilitation with riveted construction is not a preferred alternative, and has not been carried forward for analysis.

It is estimated that most repairs could be completed by reinforcing existing members with steel plates, or replacing isolated members with identical steel members. Due to the age of the steel used in the trusses, welding may not be possible to strengthen members that are left in place. Bolts would be use, and could mimic the appearance of rivets, as shown in **Figure 5 andFigure** 6 below. This would help to reduce changes in aesthetics to the bridge and soften the appearance of any rehabilitation works.

Figure 5: As viewed from the surface, bolts used adjacent to existing rivets to mimic the appearance of rivets

Figure 6: As viewed from the opposite side, these bolts resemble a typical threaded bolt and nut assembly

The repairs required to a number of steel elements are difficult to estimate due to the level of corrosion and paint covering most of these elements. Sympathetic rehabilitation would require sandblasting to remove the existing coatings and corroded steel. This would require an environmental containment system to ensure that no deleterious material enters the watercourse below the bridge. Alternatively and likely more cost effective would be to dismantle the bridge, clean, repair and restore in a shop environment and reinstall on site.

For these reasons, rehabilitation works would be difficult to scope. Significant contingencies for both time and schedule would be recommended for construction. As well, rehabilitation in either case would likely require the bridge to be closed for a prolonged duration during construction.

A bridge rehabilitated using these techniques may have a remaining useful life of approximately 15 to 25 years, depending on the scope of rehabilitation.

The substructure would need to be rehabilitated and repaired in order to maintain the ability to support the pony truss bridge and the applied loading by pedestrians and cyclists.

Additionally, the existing structure is unlikely to be able to support pedestrian loads as specified in the current Canadian Highway Bridge Design Code. Similar to road way bridges, a load rating could be applied to the structure however we are unsure how this would be effectively enforced. The MTO enforces vehicular load postings, but for pedestrians, the City's bylaw enforcement department would have to monitor and issue fines to violators. If the occupancy of the bridge exceeds the posting by a certain number of people, determining who is fined and how to enforce the load limit would be difficult if not impossible. Maintenance vehicles could be prevented from crossing the bridge through the use of bollards and signage.

This alternative would require the installation of an alternative structure to support the watermain and sanitary sewer, once the pedestrian footbridge to the south of the Norwich Street bridge was removed.

5.1.2 Alternative 2: Installation of a New Bridge Structure between the Existing Trusses

The Norwich Street bridge crossing would be reconfigured to allow for a new bridge structure to convey pedestrian and cyclist traffic while maintaining the historic steel trusses, but not relying on the steel trusses as load carrying members. Refer to **Figure 6 and Figure** 7 below, which show a similar historic steel truss bridge that was retrofitted so that traffic is conveyed on a Fibre Reinforced Polymer (FRP) bridge deck that does not rely on the steel trusses for structural support. An alternative design would be a concrete deck on steel girders that can be economically constructed. In comparison to **Figure 6 and Figure** 7, the deck would not require the tall curbs at the sides with pedestrian hand rails either included on the new deck or the existing structure. The exact structural system used to alleviate the existing bridge from the pedestrian and cyclist loads would be determined in the detailed design phase and would be designed to current standards for pedestrian bridges,

Figure 7: Similar truss bridge with FRP deck, where the steel trusses carry only their own weight

Figure 8: From the sides, the truss structure resembles a normal steel truss bridge

In either case, the existing wood deck and wood stringers would be removed to reduce the weight carried by the steel trusses while providing a cavity to place the new deck support system. The trusses could then be repaired and remain in place as an aesthetic feature supporting only their own self-weight. As the Norwich Bridge is a prominent feature of the area, providing scenic views of the Speed River, a bridge structure with an open barrier system would be most appropriate so that views are not obstructed.

A new bridge structure may need to be founded on a deep foundation system (e.g., caissons, piles) behind the existing abutments. This would alleviate loads on the deteriorating concrete retaining walls that line the Speed River. The foundation system would need to be positioned so that it does not interfere with the foundation system of the retaining walls. Therefore, a structure with a span larger than the existing Norwich Street bridge would be required.

The heritage bridge would be repaired, but not to the full extend as Alternative 1. The substructure would need to be rehabilitated and repaired in order to maintain the ability to support the pony truss bridge. Based on the existing condition of the substructure, we estimate after repairs are completed that the substructure and original bridge would have a remaining useful life of approximately 25 to 35 years.

The new structure placed between the trusses of the existing structure, on new pile foundations, would have a design life of 75 years.

This alternative would require the installation of an alternative structure to support the watermain and sanitary sewer, once the pedestrian footbridge to the south of the Norwich Street bridge was removed.

5.1.3 Alternative 3: Sympathetic Replacement of the Existing Bridge

The Norwich Street bridge would be replaced approximately in its present location. The bridge would be designed to current standards for pedestrian bridges, improving functionality and aesthetics. As the steel trusses are heritage elements, they would be replaced in identical fashion using modern construction techniques. Welding and bolts that mimic rivet connections would be used to maintain the heritage appearance of the structure.

As the City does not wish to re-open this crossing to vehicle traffic, the crossing width could be maintained and the capacity would not need to increase from the current structure. Refer to **Figure 9 and Figure** 10 for an example of a steel truss bridge that was replaced in this fashion. Note that the new bridge was designed to carry vehicle traffic to current standards, requiring that the size of some structural elements be increased. For the Norwich Street bridge, the possibility of reducing the size of structural elements may be feasible as the current bridge member sizes are likely larger than those required for pedestrian bridge loading.

Figure 9: Historic steel truss bridge that was scheduled for replacement with a modern truss structure

Figure 10: New steel truss bridge constructed with welded connections

In order to facilitate a sympathetic replacement, alternatives to expedite the construction schedule could be explored. These could include measuring, fabricating and assembling the new bridge structure in a staging area so that it may be lifted into place once the existing bridge was removed. This would reduce the length of time required for the bridge to be out of service.

Additionally, the substructure would need to be either repaired or replaced. Repairs would be similar to those mentioned in Alternative 1 and would have a remaining service life of approximately 15-25 years. At that point the bridge substructure would likely need to be replaced.

Replacement of the substructure is recommended and full be carried forward as this would allow the span to be increased to move the west abutment outside the banks of the normal flows within the Speed River. Replacement of the substructure and superstructure, would combine to extend this crossings remaining useful life to approximately 75.

The existing heritage structure could then be removed, reconditioned and place along a local trail or park for viewing.

This alternative would allow the bridge to be widened or shifted to the south slightly to support the watermain and sanitary sewer, once the pedestrian footbridge to the south of the Norwich Street bridge was removed.

5.1.4 Alternative 4: Bridge Removal (without Replacement)

This alternative would require the City to develop an appropriate bridge removal and pedestrian pathway closure strategy. Repairs to the concrete retaining walls that continue upstream and downstream of the existing bridge would be required. The west substructure could be left in place, however it constricts the water flow and would be recommended for removal.

As the Norwich Street Pedestrian Bridge is also closed, the removal of the Norwich Street bridge would completely remove pedestrian and cyclist access across the Speed River at this location.

This alternative would require the installation of an alternative structure to support the watermain and sanitary sewer, once the pedestrian footbridge to the south of the Norwich Street bridge was removed.

5.1.5 Alternative 5: Do Nothing

This alternative would see the status quo maintained in the short term; however, the bridge is nearing the end of its service life and, therefore, this alternative would ultimately lead to closure of the Norwich Street bridge. Selection of this alternative would eventually lead to the selection of one of the alternatives described in the subsequent sections.

Although the “Do Nothing” alternative would have no (or low) capital costs in the short-term, this is more accurately portrayed as a ‘deferred cost’ since the bridge would likely need to be closed near future.

This alternative would require the installation of an alternative structure to support the watermain and sanitary sewer, once the pedestrian footbridge to the south of the Norwich Street bridge was removed.

5.2 Summary of Alternatives

A summary of the advantages and disadvantages of the alternatives solutions is provided in **Table 3** below.

Table 3: Summary of Advantages and Disadvantages of Alternative Solutions

Alternative	Advantages	Disadvantages
Alternative 1: Sympathetic Restoration of the Existing Bridge	• Low capital costs in short-term • Low impacts to natural environment • Low impacts to heritage value • No adjustments to existing trail network	• Lower remaining useful life of structure as compared to other alternatives • Requires additional structure to support adjacent utilities • Greater contingencies required during construction leading to the potential for significant cost increases • Existing poor condition substructure remains in place

Alternative	Advantages	Disadvantages
Alternative 2: Installation of a new Bridge Structure between the Existing Trusses	• Low capital costs in long-term • Low impacts to natural environment • Low impacts to heritage value • No adjustments to existing trail network • Extends the life of the heritage structure beyond Alternative 1 as the concern for public safety is removed.	• More expensive than Alternative 1 in short-term • May require alternative materials to the existing wood deck, which may alter the perception of the bridge • Requires additional structure to support adjacent utilities • Would require a new foundation system to support the new structure • Existing poor condition substructure remains in place
Alternative 3: Sympathetic Replacement of the Existing Bridge	• Improvements to safety can be easily made • Allows for slight realignments so that adjacent utilities can be supported by new structure • Opportunity to incorporate design improvements to the bridge • Existing structure can be removed and displayed elsewhere for viewing • New structure could be built in staging area and lifted into place for reduce construction duration • Provides opportunity to move west abutment outside of normal flows/high water mark removing river constriction	• Highest capital cost in short-term • Completely removes existing heritage structure from location • Long-term closure during construction required • Greatest potential for overhead utility conflicts during construction • Would likely require a Stage 2 Archeological Assessment
Alternative 4 – Bridge Removal (without Replacement)	• Low capital costs in short and long-term • Removes safety issue due to deteriorated bridge condition • Existing structure can be removed and displayed elsewhere	• Severs a highly utilized pedestrian link across the Speed River • Completely removes existing heritage structure from location • Requires additional structure to support adjacent utilities
Alternative 5 – Do Nothing	• Lowest capital costs in short and long-term	• Leads to one of the above alternatives in the next 1-10 years depending on future structural inspections and rate of deterioration of bridge condition

5.3 Preliminary Costs

Preliminary cost estimates were prepared for the capital works associated with each alternative. Maintenance costs have not been included; however, maintenance costs for a rehabilitated structure would be substantially more than those required for a new bridge structure, or for the option where a new structure is installed between the existing steel trusses. Other considerations for rehabilitation would include the remaining useful life of the structure before the next major rehabilitation or replacement is required. A rehabilitated structure would be anticipated to have a remaining useful life of approximately 20 to 30 years before another major rehabilitation or replacement of key components would be required.

Preliminary capital cost estimates have been summarized in **Table 4** below. These costs also do not include other expenses (property, engineering, contingencies, utility relocation, HST, etc.).

Table 4: Preliminary Capital Cost Estimates

Alternative	Capital Cost
Alternative 1: Sympathetic Restoration of the Existing Bridge	$ 500,000
Alternative 2: Installation of a new Bridge Structure between the Existing Trusses	$ 750,000
Alternative 3: Sympathetic Replacement of the Existing Bridge	$ 1,200,000
Alternative 4: Bridge Removal (without Replacement)	$ 200,000
Alternative 5: Do Nothing (Close Bridge)	$ 10,000

5.4 Assessment and Evaluation of Alternatives

The selection process for the Preferred Alternative Solution involves two steps: Assessment of Alternatives (Step 1) and Evaluation of Alternatives (Step 2). These steps are described below, with the results provided in **Table 5**.

Alternatives 4 and 5 do not address the requirements or objectives of the City and are strongly opposed by the public and other stakeholders. Therefore, these alternatives have been screened out and removed from further consideration for the comparative assessment and evaluation.

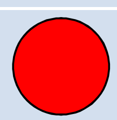
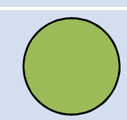
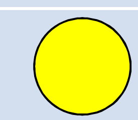
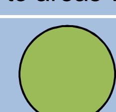
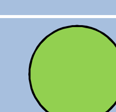
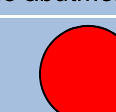
5.4.1 Assessment of Alternatives

The potential benefits and impacts of each alternative are assessed against social, cultural, natural, technical and economic factors. The assessment is based on the existing environmental conditions compiled through field visits and secondary source information, as summarized in **Section 4**. The preliminary assessment was made available to stakeholders in March 2017 for review and comment.

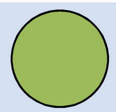
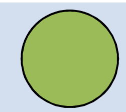
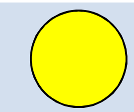
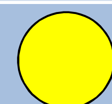
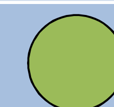
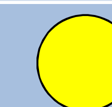
5.4.2 Evaluation of Alternatives

A comparative examination of the advantages and disadvantages of the alternatives was completed based on the assessment. The evaluation was carried out using the Reasoned Argument method, comparing differences in impacts and providing a clear rationale for the selection of the preferred alternative.

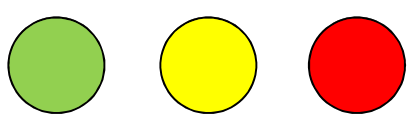
Table 5: Assessment and Evaluation of Alternative Solutions

Factor/Criteria	Alternative 1 Sympathetic Restoration of the Existing Bridge	Alternative 2 Installation of a new Bridge Structure between the Existing Trusses	Alternative 3 Sympathetic Replacement of the Existing Bridge
Socio-Economic Environment • Property Impacts • Impacts to Businesses and Adjacent Land Uses • Community Connectivity and Mobility including Cyclist/Pedestrian Movement • Visual Impacts • Public Safety	• No property acquisitions required. • Requires longer-duration closure during construction requiring more pedestrian and cyclist traffic movements to Eramosa Road bridge, which is less pedestrian and cyclist friendly. • Maintains the existing crossing as a connecting link between the adjacent neighbourhood and downtown. • Maintains travelled width of current structure. • No impacts to adjacent property or businesses upon completion of construction. • Major restorations would primarily take place below the bridge deck, minimizing aesthetic changes that are visible. • Greater likelihood of additional closures in the near future for additional repairs to the bridge. • Does not address the current day design standard for pedestrian bridge loading which is above the prior theoretical load capacity assessments.	• No property acquisitions required. • Requires a moderate closure during construction requiring more pedestrian and cyclist traffic movements to Eramosa Road bridge, which is less pedestrian and cyclist friendly. • Maintains the existing crossing as a connecting link between the adjacent neighbourhood and downtown. • May slightly narrow the travelled width of the new crossing structure. • No impacts to adjacent property or businesses upon completion of construction. • Maintains existing bridge trusses as architectural feature with moderate restoration. • Appearance of bridge would change with addition of new structure between trusses. • Minor vertical adjustments would be required to the trail network at the approaches to the bridge. • Repairs to the original bridge and supporting structure would be required in the not too distant future. • New structure could support current day pedestrian loading improving public safety.	• No property acquisitions required. • Could require a short closure if new structure is constructed in a staging area reducing pedestrian and cyclist traffic movements to Eramosa Road bridge, which is less pedestrian and cyclist friendly. • Extended closure would occur if abutments where reconstructed. • Maintains the existing crossing as a connecting link between the adjacent neighbourhood and downtown. • Opportunities to widen the travelled width of the structure can be explored. • Views of river and surrounding area could be enhanced as a part of the replacement. • No impacts to adjacent property or businesses upon completion of construction. • Completely removes existing bridge. • Would need to construct a new bridge that is visually similar to the existing structure. • The adjacent utilities could potentially be supported from the new structure, which would improve site lines and views of the downstream watercourse. • New structure could support current day pedestrian loading improving public safety.
			
Cultural Environment • Built Heritage • Archaeological Potential	• Retains bridge structure elements that are deemed to have heritage value. • Major restoration works on heritage elements would need to be reviewed to ensure they are consistent with the style of the element. • No anticipated impacts to areas with archaeological potential.	• Retains bridge structure elements that are deemed to have heritage value. • Moderate structural repairs to heritage elements required to extend life of structure. • No anticipated impacts to areas with archaeological potential.	• Results in the removal of the bridge trusses that are deemed to have heritage value. • Heritage elements would need to be salvaged for incorporation into the new structure or to be put on display at another location. • A Stage 2 Archaeological Assessment would be required to extend the west bridge abutment outside of the watercourse.
			

Factor/Criteria	Alternative 1 Sympathetic Restoration of the Existing Bridge	Alternative 2 Installation of a new Bridge Structure between the Existing Trusses	Alternative 3 Sympathetic Replacement of the Existing Bridge
Natural Environment • Aquatic Habitat and Fish Passage • Vegetation • Wildlife and Habitat • Species at Risk	• Minor clearing of vegetation in vicinity of structure is required to facilitate works. • No permanent changes to in-water footprint or changes to fish passage, though some temporary works may be required during construction. • Although no nests were observed, the existing structure could be a potential nesting area for birds if rehabilitated.	• Minor clearing of vegetation in vicinity of structure is required to facilitate works. • No permanent changes to in-water footprint or changes to fish passage, though some temporary works may be required during construction. • Although no nests were observed, the new structure through the existing trusses may not provide any potential nesting areas for birds.	• Minor clearing of vegetation in vicinity of structure is required to facilitate works. • No permanent changes to in-water footprint or changes to fish passage, though some temporary works may be required during construction. • Although no nests were observed, the new structure may provide potential nesting areas for birds. • Replacement of abutments and footings would have short term impacts to the river. • Allows for moving the west abutment out of normal/high water levels removing existing constriction of the river.
Technical Environment • Design Standards • Utilities • Constructability • Structure Longevity	• Rehabilitation may not be able to resolve all structural issues with bridge such as the pin connections, bearings and structural capacity issues. • Salting of the bridge during winter months will continue to deteriorate steel elements and cause coating failure. • Minimal opportunity for design improvements to railings, deck and approaches. • Minimal impacts to existing utilities assuming the structure is repaired in place. • An additional structure is required to support the water and sanitary utilities south of the bridge. • Superstructure and substructure would likely require additional repairs or complete replacement in the next 15-25 years.	• New structure would be designed to current code standards. • Trusses would only support their own weight, which would increase their useful life. • Existing deck is near the end of its useful life, so its removal is at an opportune time. • Coordination with Guelph Hydro for use of a crane on site would likely be required. • Independent foundations would be required beyond the existing concrete abutments, so only superficial/preventative repairs to the existing abutments and channel walls may be explored. • An additional structure is required to support the water and sanitary utilities south of the bridge. • Estimated useful life of new superstructure would be 75 years. • Substructure and heritage structure would likely require additional repairs or complete replacement in the next 25 -35 years.	• New structure would be designed to current code standards. Full replacement of substructure. • Coordination with Guelph Hydro for use of a crane on site would likely be required. • Estimated useful life of new structure would be 75 years. • Opportunities to support the adjacent water and sanitary utilities from the new structure could be explored.

Factor/Criteria	Alternative 1 Sympathetic Restoration of the Existing Bridge	Alternative 2 Installation of a new Bridge Structure between the Existing Trusses	Alternative 3 Sympathetic Replacement of the Existing Bridge
Economic Considerations • Capital and Life Cycle Costs	• Capital cost of rehabilitation = $ 500,000 • Maintenance costs would be low initially and increase significantly over time as other structural members continue to deteriorate. • Lowest immediate capital cost delaying substructure and super structure replacement. • Major rehabilitation or replacement anticipated in 15 to 25 years (estimated remaining service life).	• Capital Cost or Rehabilitation = $ 750,000 • Maintenance costs would be minimal in the short-term and gradually increase over time (if timber components are utilized) or remain relatively constant until first significant repair in 30-50 years. • Remaining useful life of structure depends on repairing abutments and preventing further deterioration. • Major rehabilitation or replacement of supporting structure anticipated in 25 to 35 years (estimated remaining service life).	• Capital Cost = $ 1,200,000 • Largest capital cost in the short term, but provides opportunity for maximized design life. • Maintenance costs would be minimal in the short-term and gradually increase over time (if timber components are utilized) or remain relatively constant until first significant repair in 30-50 years. • Has the highest capital cost, however extends any major rehabilitation beyond 50 years.
			
CONCLUSION	 11		
		Alternative 2 is the most preferred alternative.	

Evaluation Legend:



Most Preferred ⟶ Least Preferred

6. RECOMMENDED ALTERNATIVE

6.1 Description of Recommended Alternative

Based on the Assessment and Evaluation of Alternatives presented in **Section 5**, the preferred solution recommended for approval by Council is Alternative 2: Installation of a New Bridge Structure between the Existing Trusses.

This alternative offers the City the best opportunity to maintain the existing trusses as it preserves them in place as primarily an aesthetic feature. By installing a self-supporting structure, the existing trusses and supporting structure would only be required to carry their own weight, which represents a significant reduction in total load to be carried by the elements. The new structure would be able to provide a safe crossing over the Speed River and be designed to better accommodate drainage, salting and sanding of the deck and pedestrian barriers.

The bridge structure should be designed as a pedestrian crossing, designed for pedestrian and maintenance vehicle loading as well as appropriate deflection limits as per CSA S6-14 (the Canadian Highway Bridge Design Code) and the MTO's Structural Manual. The City has expressed the desire to maintain this structure only as a pedestrian crossing. Therefore, there is no need to provide any allowances for future vehicle loading.

The existing watermain and sanitary sewer located south of the existing trusses are currently supported by the Norwich Street pedestrian bridge, which is currently closed. This bridge structure should be removed and replaced with a structure to support the watermain and sanitary sewer pipes. Appropriate fencing and signage will need to be provided to prohibit public access to the structure.

6.2 Environment Impacts and Mitigation Measures

6.2.1 Socio-Economic Environment Impacts and Mitigation

During construction of the new bridge structure, the pedestrian and cyclist path will be closed to traffic. Given the nature of the existing structure and proposed works, there do not appear to be any opportunities to stage construction so that pedestrians and cyclists can continue to use the crossing.

6.2.2 Cultural Environment Impacts and Mitigation

6.2.3 Natural Environment Impacts and Mitigation

6.2.4 Technical Environment Impacts and Mitigation

APPENDIX A:
CULTURAL HERITAGE EVALUATION
& HERITAGE IMPACT ASSESSMENT

APPENDIX B:
STAGE 1 ARCHAEOLOGICAL ASSESSMENT

APPENDIX C:
SCOPED ENVIRONMENTAL IMPACT STUDY

APPENDIX D:
RECENT STRUCTURAL INSPECTIONS

APPENDIX E:
EXCERPTS FROM SPEED RIVER HEC-RAS MODEL