



Region of Waterloo

Transportation and Environmental Services

Design and Construction

To: Chair Elizabeth Clarke and Members of Regional Council

Date: July 15, 2020 **File Code:** 05914(H), 07626(H)

**Subject: West Montrose Covered Bridge
Rehabilitation Strategy and Preservation Plan Update
Township of Woolwich**

Recommendation:

That the Regional Municipality of Waterloo take the following actions with respect to the proposed rehabilitation and preservation of the West Montrose Covered Bridge:

- a) Approve the proposed rehabilitation strategy for the West Montrose Covered Bridge as described in this Report TES-DCS-20-14, dated July 15, 2020; and
- b) Enter into a Consulting Services Agreement with Doug Dixon and Associates to provide engineering consulting services for preliminary design, detailed design, contract administration and construction inspection services for the West Montrose Covered Bridge in the Township of Woolwich at an upset fee limit of \$179,827.50 plus applicable taxes for the preliminary design and detailed design phases, with contract administration and construction inspection services to be paid on a time basis, as described in this Report TES-DCS-20-14, dated July 15, 2020.

Summary:

In 1998, the Ministry of Transportation transferred ownership of the West Montrose Covered Bridge to the Region of Waterloo. Since then, the Region has completed rehabilitation work on the bridge and prepared a Preservation Plan in 2014. The Region then retained a specialty bridge engineering consultant to conduct a detailed structural analysis of the bridge. The engineering consultant has recommended that the steel Bailey trusses in the bridge be replaced with robust steel trusses or girders, designed and built specifically for the purpose of carrying the loads of the West Montrose Bridge. These trusses or girders can be concealed by cladding in the same manner that the

existing Bailey trusses are concealed by cladding. Staff is currently also assessing the feasibility of raising the bridge somewhat in order to reduce its susceptibility to flooding and ice forces.

Engineering design for the West Montrose Covered Bridge rehabilitation requires specialist bridge engineering expertise. Awarding this assignment to Doug Dixon and Associates would save the time and expense of locating and selecting another comparably qualified engineering firm, as well as the time and expense of another firm familiarizing themselves with the unique complexities of this bridge. Accordingly, staff recommends that Council approve the retention of Doug Dixon and Associates to complete the West Montrose project at an upset fee limit of \$179,827.50 plus applicable taxes for the preliminary design and detailed design phases, with contract administration and construction inspection services to be paid on a time basis.

The estimated project cost including bridge works, road works, engineering, and site inspection will range between \$3,500,000 and \$6,000,000 depending on the final scope of work approved by Council. The wide range in estimated cost is related to the possibility that the structure may need to be raised in order to provide improved resilience against flooding and other weather events.

Once the detailed engineering design has progressed to a sufficiently advanced state, staff will present a follow-up report to Council outlining the proposed works in more detail, with a refined cost estimate.

Report:

1. Background Chronology

A brief chronology of the West Montrose Covered Bridge is as follows.

Original Construction and Ministry Retrofit Work (1881 - 1998)

In 1881, the bridge was constructed. The two span bridge employed wooden trusses to support the bridge loads. Please refer to **Appendix A** for a Key Plan showing the bridge location.

In 1937, the Ontario Department of Highways (now the Ministry of Transportation) assumed ownership of the bridge.

In 1950, the Ministry of Transportation supplemented the strength of the wooden trusses through the addition of steel World War II era Bailey trusses, manufactured in 1944. These trusses remain in place today inside the bridge, hidden from view by the use of white wood cladding.

In 1959, the Ministry of Transportation added supplemental steel longitudinal reinforcing rods below the bottom chords of the wooden trusses.

In 1967, the Grand River Conservation Authority (“GRCA”) installed a flow and water level monitoring station at West Montrose. A number of flood events have affected the West Montrose area in the subsequent 50-year period. In general, the water levels encountered have not been sufficient to reach the underside of the West Montrose bridge; however, with changing climate and weather events, the bridge could be susceptible to severe damage or total loss in an extreme weather event.

Transfer of Ownership to the Region of Waterloo (1998 - 2012)

In 1998, the Ministry of Transportation transferred ownership of the bridge to the Region of Waterloo.

In 1999, the Region undertook a major rehabilitation of the bridge. Portions of the steel Bailey trusses were upgraded. Various wooden components were also replaced.

In 2003, the Region undertook repointing of the central masonry pier.

In 2011, the Region repaired the bearing seats at the abutments.

In 2012, a wood beam was damaged by an overweight vehicle. The Region subsequently replaced the beam.

Please refer to **Appendix B** for detailed photos of the bridge and its components.

2014 Preservation Plan and Follow-Up (2014 - Present)

In 2014, staff presented a 10-year Preservation Plan. Key elements of the plan included installation of fire and lightning protection, regulatory and advisory signage improvements, approach barrier upgrades, bracing restoration, climate studies, survey sensor installation, sprinkler installation, illumination upgrades, floor beam strengthening and overall structural strengthening. The 2014 Preservation Plan is available via the following link:

www.regionofwaterloo.ca/en/living-here/construction-and-road-closures.aspx?_mid_=25142

In 2017, Region staff prepared an update memo to interested stakeholders. A fire alarm system had been installed. Signage had been installed at, and in advance of, the bridge to advise of the load limit. The approach guide rails had been updated to current code standards. Historic (though non-functional) lateral bracing under the structure had been tightened. A surface treatment had been applied to the deck. A sprinkler system was being investigated. A new illumination system was being designed.

In 2018, Region staff prepared an update memo to interested stakeholders. Development continued on a proposed sprinkler system. Structural sensors had been installed and were gathering data regarding structural behaviour. Illumination was scheduled for installation and subsequently installed.

In 2019, a wood beam was damaged by an overweight vehicle. The Region subsequently replaced the beam.

In 2019, Region staff worked with a specialist bridge engineering consultant to compile the data that had been gathered and to undertake a global assessment of the structure. This assessment resulted in the development of a concept for strengthening of the structure, as described in this Report TES-DCS-20-14.

2. Structural Analyses and Preservation Plan Update

Between 2012 and 2018, the Region undertook a number of field studies and analyses to determine the structural behaviour of the hybrid dual truss system (consisting of the original 1881 wood truss and the supplemental 1944 steel Bailey truss). The principal ultimate findings were as follows:

- The dead load (i.e. weight of the bridge itself) and live loads (i.e. weight of vehicles, pedestrians, snow, etc.), are being carried by both the original wooden truss and the steel Bailey trusses.
- As the original wood trusses age, they are “shedding” (transferring) load to the Bailey trusses.
- The Bailey trusses do not have sufficient capacity to carry the entire load of the bridge. Accordingly, if sufficient load is shed by the wooden trusses onto the Bailey trusses, the Bailey trusses could become overloaded leading to the collapse and loss of the bridge.
- The Bailey trusses (manufactured in 1944) are now 76 years old and cannot be readily retrofitted to achieve a strength sufficient to carry the entire load of the bridge.
- The life of the bridge and the safety of the bridge cannot be addressed through restriction of the bridge to pedestrian-only traffic. For example, a tour group of 40 adults on foot imposes a weight approximately equal to two passenger vehicles plus occupants.
- For the best assurance of safety of the structure and its users, the bridge should undergo a major rehabilitation intended to provide a single robust load bearing system capable of supporting all dead and live loads imposed on the bridge.

The results of the structural analyses, as well as documentation of the works undertaken since the 2014 Preservation Plan are included in a 2020 Preservation Plan Update in **Appendix C**.

3. Recommended Rehabilitation Strategy

The Region retained a specialty bridge engineering consultant, Doug Dixon and Associates to conduct a detailed structural analysis and identification of rehabilitation options. The engineering consultant has recommended that the rehabilitation should include the removal of the steel Bailey trusses and replacement with robust steel trusses or girders, designed and built specifically for the purpose of carrying the loads of the West Montrose Bridge. These trusses or girders can be concealed by cladding in

the same manner that the existing Bailey trusses are concealed by cladding. Please refer to **Appendix D** for diagrams showing the proposed rehabilitation concept.

Subsequent to construction of the robust structural system, other functional and aesthetic work is recommended. This would include repair or replacement of the roof and external cladding of the structure. Other considerations include a fire suppression system, implementation of security cameras and other measures to prevent entry by unauthorized vehicles.

Staff is currently also assessing the feasibility of raising the bridge somewhat in order to reduce its susceptibility to flooding and ice forces.

4. Interim Structural Inspection and Monitoring

In March 2020, the Region's specialty bridge engineering consultant, Doug Dixon & Associates completed an inspection of the West Montrose Bridge. No fundamental changes were observed that would warrant immediate extraordinary measures at this time; however, DDA confirms that the proposed major rehabilitation project should proceed without delay.

5. Retention of a Consulting Engineer for Detailed Rehabilitation Design

Engineering design for the West Montrose Covered Bridge rehabilitation requires specialist bridge engineering expertise. Accordingly, staff do not recommend that a bridge engineering consultant be retained through the Region's typical Request for Proposal (RFP) process; rather, staff recommend direct retention of a specialist bridge engineering firm with a breadth and depth of expertise in complex structural systems.

Doug Dixon and Associates ("DDA") has provided key insights into the behaviour and durability of the West Montrose Bridge through the above-noted assignment. Accordingly, staff are recommending that the Region retain DDA directly for this assignment.

DDA is one of Canada's only specialist bridge engineering services firms. DDA has a focus on unique and challenging bridge engineering assignments. The Principal and founder of the firm, Doug Dixon, M.A.Sc., P.Eng., has more than 35 years of bridge engineering experience. Mr. Dixon has played a key role in the rehabilitation of a number of Ontario's most notable heritage bridges, including the Little Current Swing Bridge (Manitoulin Island), Wasauksing Swing Bridge (Parry Sound), Prince Edward Viaduct (Toronto), Queen Street Bridge over Don River (Toronto), Bathurst Street Bridge (Toronto), Ports Toronto Ship Channel Bascule Bridge (Toronto) and Argyle Street Bridge over the Grand River (Caledonia). These projects have involved public consultation and the development of rehabilitation details to provide safe and durable bridges while retaining the important heritage features of each. Mr. Dixon is also a member of three Technical Subcommittees for the Canadian Highway Bridge Design

Code, including Rehabilitation and Joints & Bearings (as sub-committee Chair).

DDA has provided the Region with a quotation in the amount of \$179,827.50 for detailed design services for this project. DDA will also be available to provide on-site contract administration and inspection (“CA&I”) services during construction, to be paid on a time basis. For preliminary budget purposes, staff estimates that the cost of the CA&I services will be approximately \$300,000.

Staff has reviewed the DDA quote and has determined that it is fair and reasonable and consistent with current market costs for such specialty services. Awarding this assignment to DDA would save the time and expense of locating and selecting another comparably qualified engineering firm, as well as the time and expense of another firm familiarizing themselves with the unique complexities of this bridge. Accordingly, staff recommends that Council approve the retention of Doug Dixon and Associates to complete the West Montrose project. This recommendation conforms with the Region’s Purchasing By-law Part VII, 21(1)(g) as the extension of the previous contract with DDA would prove more cost-effective and beneficial for the Region.

6. Public Consultation

Plans for the rehabilitation will be presented to the public for information and comment through a public engagement process. This will include a project page on the Region’s website and/or engagewr.ca, the Region’s virtual public engagement tool.

Notification of this project will include property owner and stakeholder mail-outs, emails social media posts, and road signs. All of these will include a link to the Region’s website and/or engagewr.ca for instructions on how to view project information and submit questions and comments.

In order to ensure that engagement is accessible for all stakeholders, options will also be provided to request paper or other alternative copies of all project information, and to submit questions and comments by mail, email, telephone or other alternative format.

7. Traffic Staging During Construction

Construction of the rehabilitation will require the full closure of the West Montrose bridge to all motorized vehicles and horse-and-buggy traffic for up to one full year.

It is currently believed that the bridge can remain open to pedestrians and cyclists for most of the construction period; however, there will be critical phases where the bridge will be unavailable to pedestrians and cyclists for an estimated period of up to two weeks.

Detour routes will be established and efforts will be made to make these routes as convenient and safe as possible for all road users, including horse-and-buggy traffic, pedestrians, cyclists and motorists.

More detailed information will be made available prior to construction, through letters to adjacent property owners and tenants, sign boards and postings to the Region's web site and/or the Region's engagewr.ca platform.

8. Project Timing

Subject to approval of the proposed improvements by Council, the tentative schedule for this project is as follows:

Detailed Engineering Design	2020 - 2021
Construction Start	Spring 2022
Construction Completion	Spring 2023

9. Estimated Project Cost

The estimated project cost including bridge works, road works, engineering, and site inspection will range between \$3,500,000 and \$6,000,000 depending on the final scope of work approved by Council. The wide range in estimated cost is related to the possibility that the structure may need to be raised in order to provide improved resilience against flooding and other weather events.

Once the detailed engineering design has progressed to a sufficiently advanced state, staff will present a follow-up report to Council outlining the proposed works in more detail, with a refined cost estimate.

Corporate Strategic Plan:

The project supports the 2019-2023 Corporate Strategic Plan objectives to increase participation in active forms of transportation (cycling and walking) and improve road safety for all users: drivers, cyclists, and pedestrians; and to support the arts, culture and heritage sectors to enrich the lives of residents and attract visitors to Waterloo Region.

Financial Implications:

The Region's approved 2020 -2029 Transportation Capital Program includes a budget of \$1,450,000 in 2020 and \$4,200,000 in 2021 for project 07626 West Montrose Bridge Rehabilitation (budget was previously included in project 05914 West Montrose Covered Bridge at Grand River), to be funded from Investing in Canada Infrastructure Program (64%, \$3,650,000), levy supported debentures (24%, \$1,350,000) and the Transportation Capital Reserve (12% \$650,000). Debt servicing costs to be recovered from future Transportation operating budgets are estimated to be \$152,300 annually over a period of 10 years on an estimated cost of borrowing of 2.25%

The Region has applied for ICIP funding under the Community Culture and Recreation Stream. This is a competitive process with many applicants. Currently, there has been no funding announcements indicating which applicants have been successful in securing funding. Staff will continue to monitor the application process and amend the 2021 Capital budget for the cost and timing of expenditures as defined during the detailed design phase of this project as well as the outcomes of the application process.

It should be noted that the current design engagement would be funded from Transportation Capital Reserve in 2020.

Other Department Consultations:

Corporate Services (Procurement) were consulted in the preparation of this report.

Attachments:

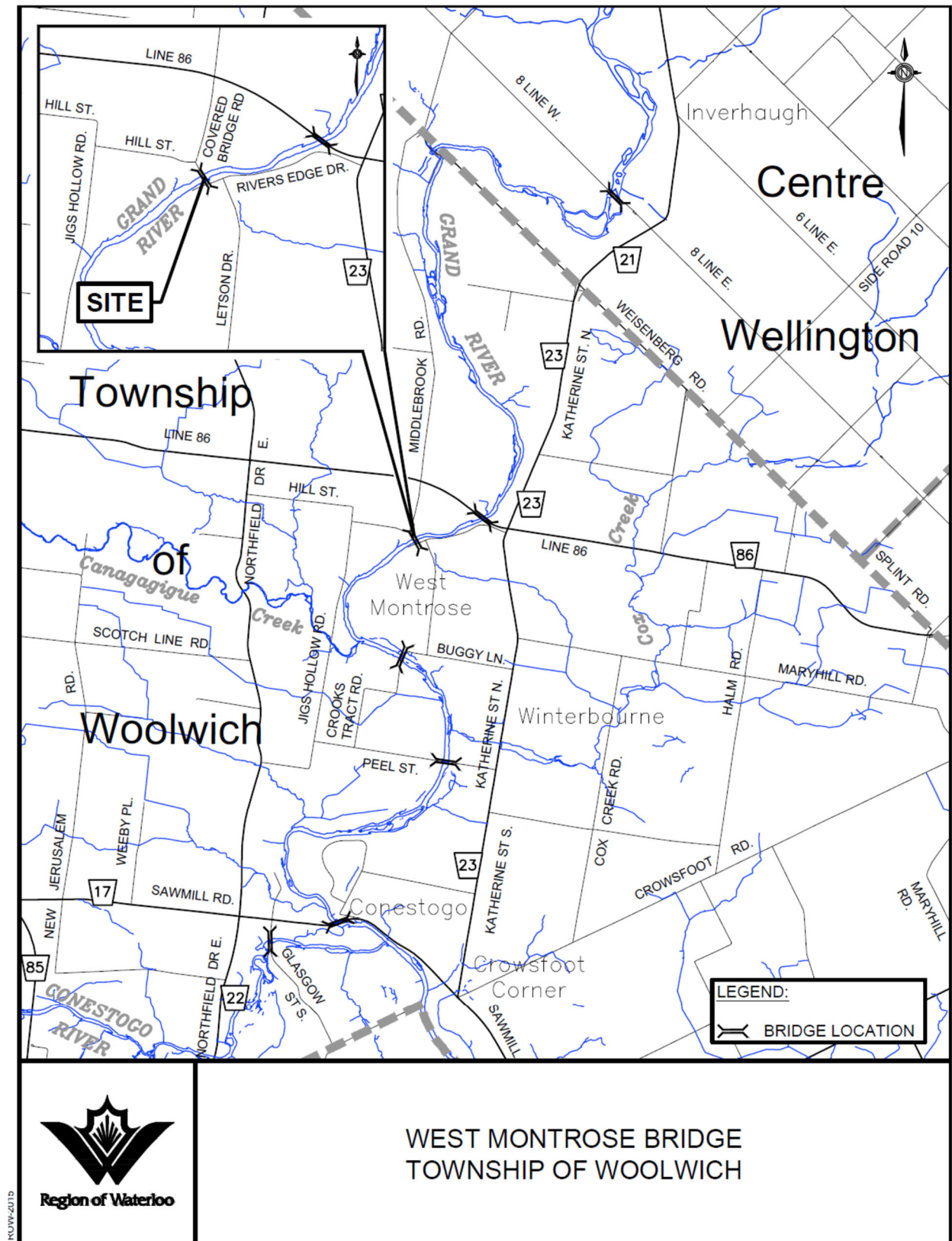
- Appendix A Project Key Plan
- Appendix B Photos of Existing Bridge
- Appendix C 2020 Preservation Plan Update
- Appendix D Proposed Rehabilitation Concept

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Approved By: Thomas Schmidt, Commissioner, Transportation and Environmental Services

Appendix A

Key Plan



Appendix B

Photos of Existing Bridge

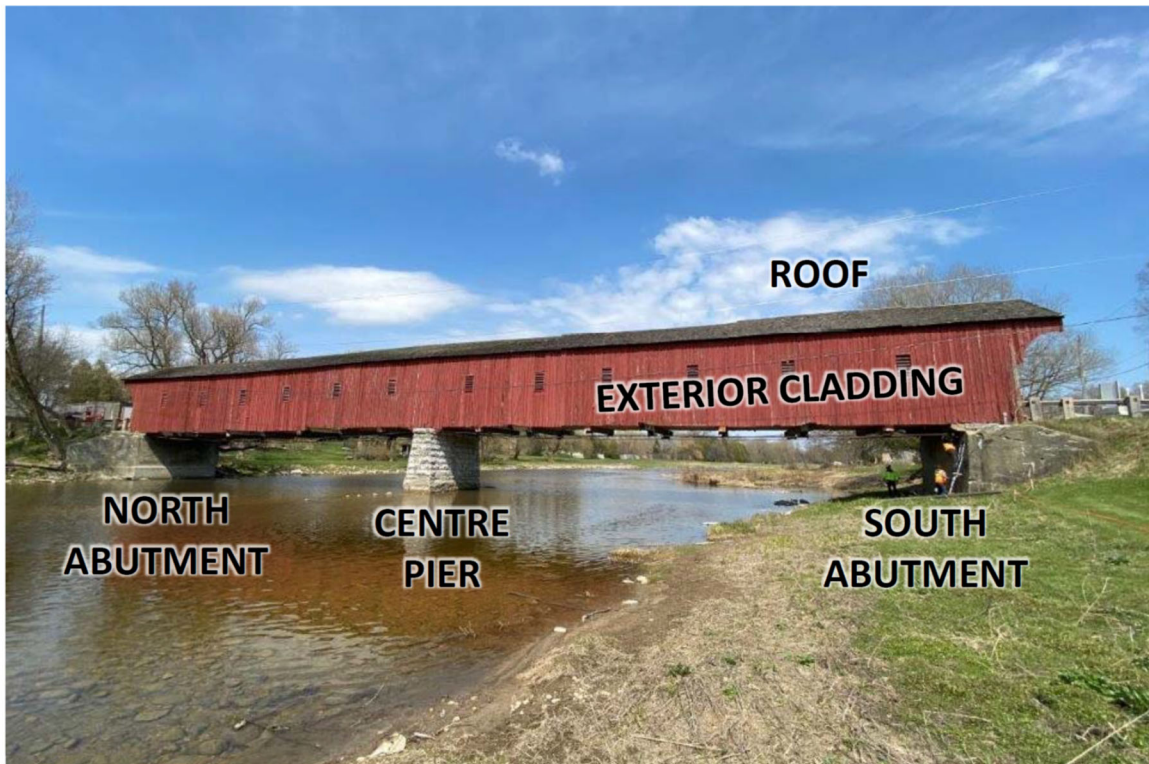


Figure B1: Elevation View



Figure B2: Exterior View



Figure B3: Exterior View

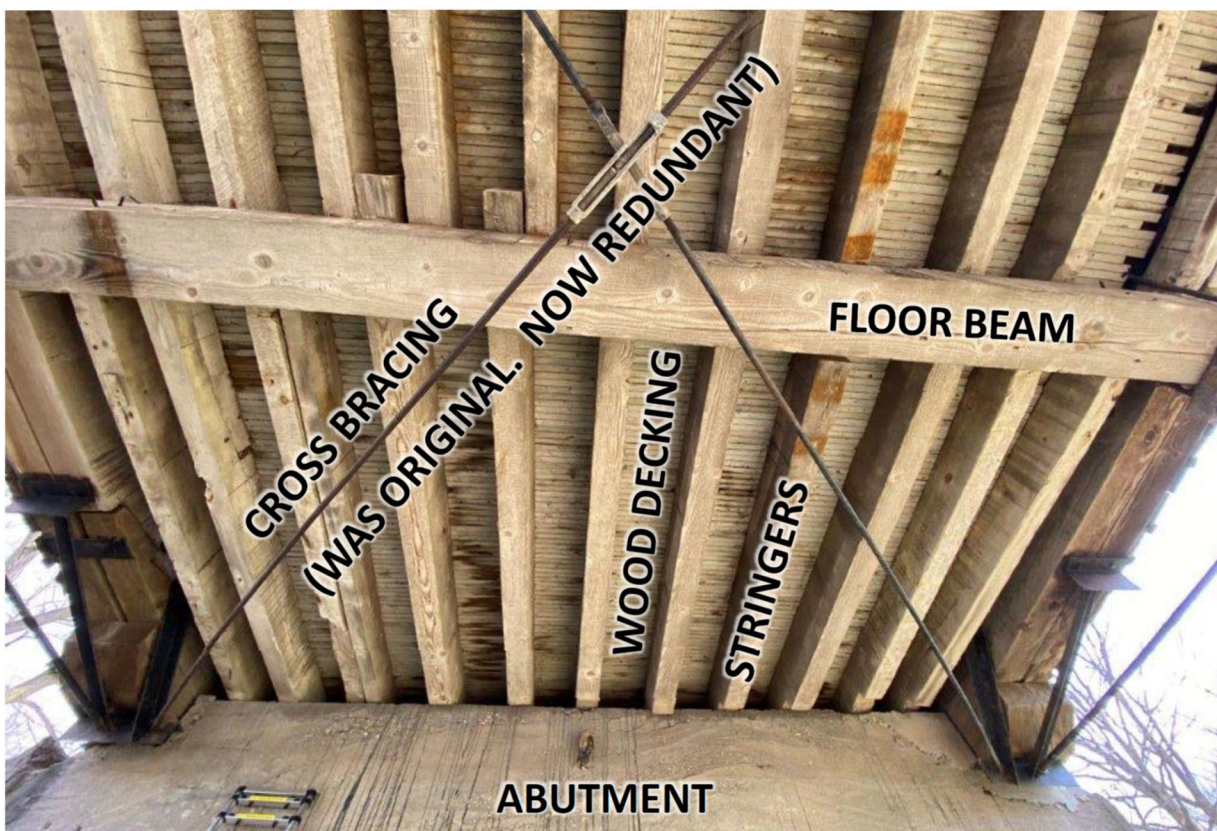


Figure B4: Underside View

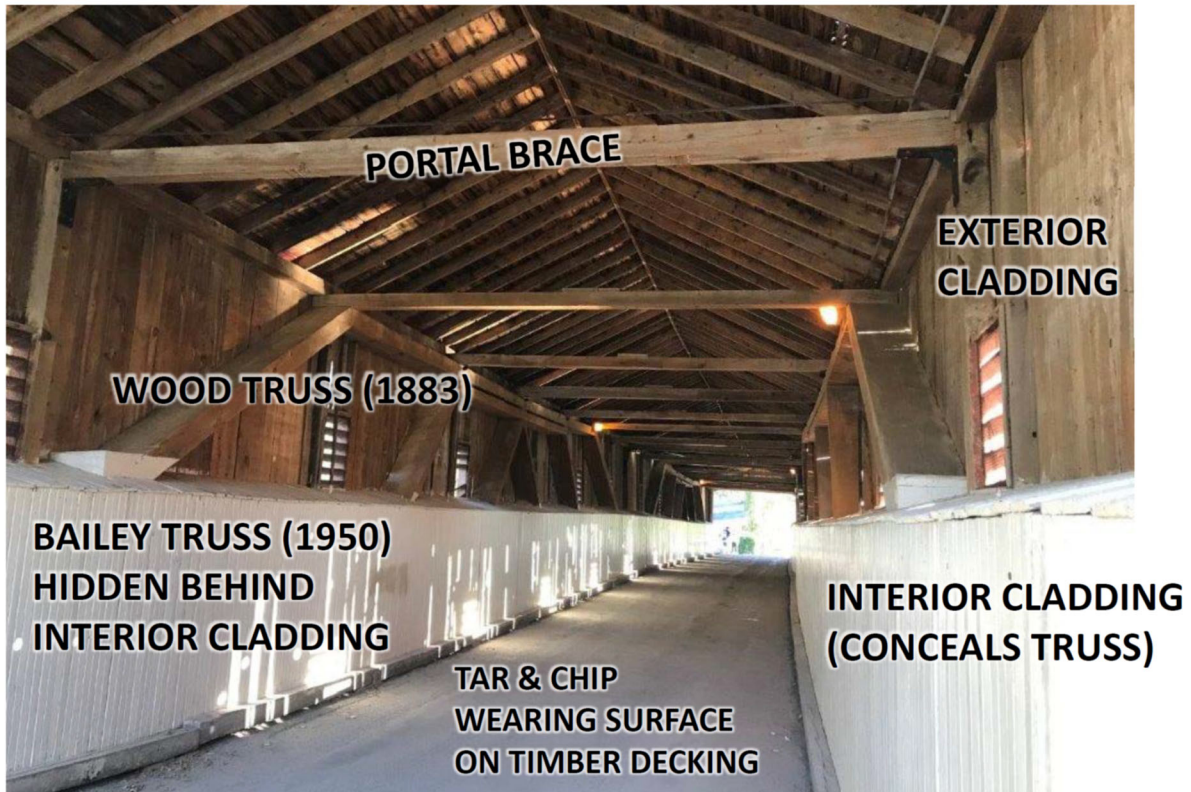


Figure B5: Interior View

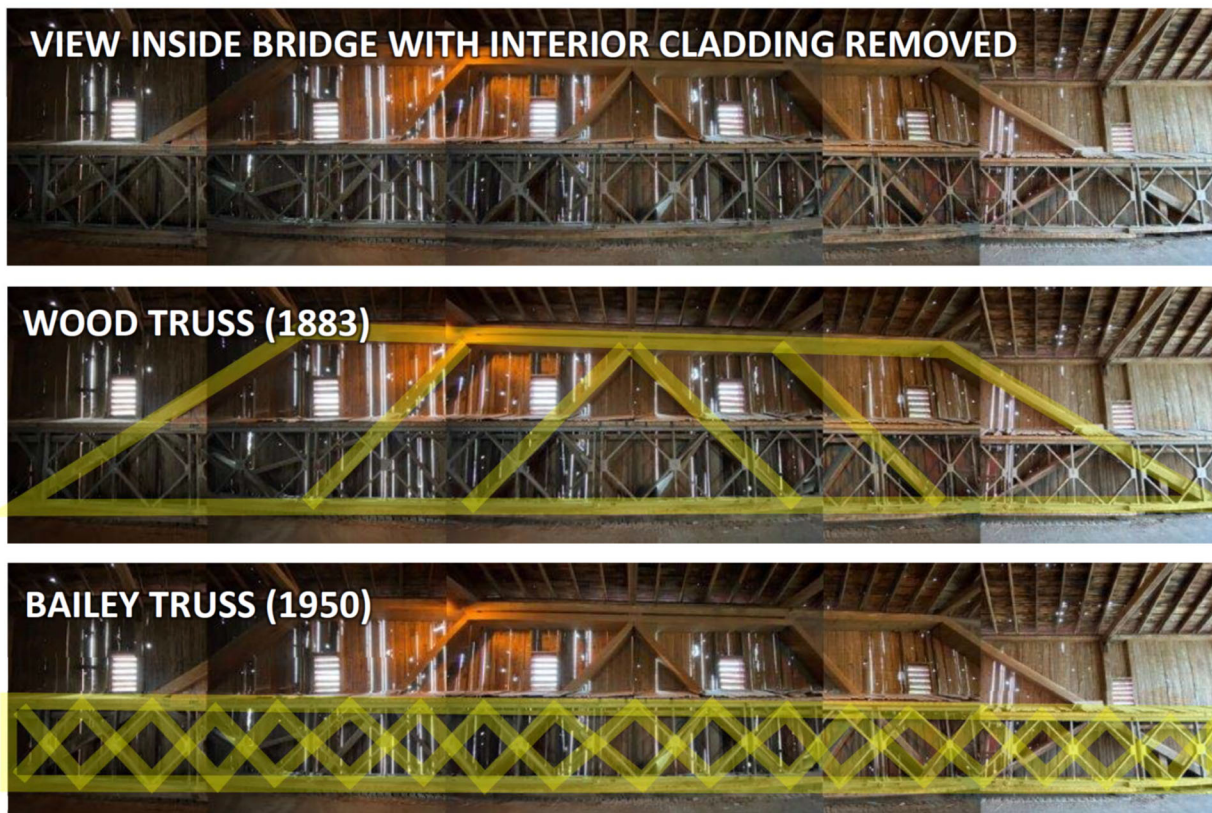


Figure B6: Interior View of Truss Systems



Figure B7: Interior View of Bailey Truss



Figure B8: Aerial View of June 2017 Flooding

Appendix C

2020 Preservation Plan Update



West Montrose Covered Bridge
Preservation Plan

2020 Update

1. HISTORY

In 2014, staff presented a 10-year Preservation Plan. Key elements of the plan included installation of fire and lightning protection, regulatory and advisory signage improvements, approach barrier upgrades, bracing restoration, climate studies, survey sensor installation, sprinkler installation, illumination upgrades, floor beam strengthening and overall structural strengthening. Please refer to Appendix “C” for a copy of the 2014 Preservation Plan.

In 2017, Region staff prepared an update memo to interested stakeholders. A fire alarm system had been installed. Signage had been installed at and in advance of the bridge to advise of the load limit. The approach guide rails had been updated to current code standards. Historic (though non-functional) lateral bracing under the structure had been tightened. A surface treatment had been applied to the deck. A sprinkler system was being investigated. A new illumination system was being designed.

In 2018, Region staff prepared an update memo to interested stakeholders. Development continued on a proposed sprinkler system. Structural sensors had been installed and were gathering data regarding structural behaviour. Illumination was scheduled for installation (and subsequently installed).

In 2019, Region staff worked with a bridge engineering consultant to compile the data that had been gathered and to undertake a global assessment of the structure. This assessment resulted in the development of a concept for strengthening of the structure.

2. 2020 PRESERVATION PLAN UPDATE

This document provides a summary of the recommendations of the 2014 Preservation Plan, along with the actions undertaken since 2014 and the current recommendations for major rehabilitation.

This information is provided in tabular form as follows:

Climate Studies

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Suggested review of historic and recent river levels to assess the threat of damage by flooding.	N/A	N/A	Staff and GRCA have met to review historic river level and flood data. Water levels have risen to the underside of the bridge in several instances since 1967. GRCA has implemented ongoing river flow controls since 1967. The occurrence of flood levels high enough to damage the bridge exist but are not considered frequent. There is limited opportunity to raise the bridge given the roadway profile and adjacent homes on River's Edge Drive. Elimination of redundant X-bracing (believed to be a replacement of the original bracing) and steel bottom chord bracing (added by Ministry in 1959) would have some beneficial effect in reducing the chance of flood damage.

Warning and Load Restriction Signs

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Installation of additional load restriction signs (including signs specifically restricting tractors, buses, trucks and limousines from using the bridge) had been recently installed.			Additional measures to physically prevent over-height vehicles from entering the bridge will be revisited.
Installation of early warning signs on routes leading to the bridge had been installed.			

Approach Road Safety

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
It was noted that the current guide-cable system at the bridge does not provide adequate protection to errant vehicles.	The guide cable system was removed and replaced with a timber guide rail system better equipped to contain errant vehicles.	N/A	N/A

Fire Alarm and Fire Suppression System

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
A fire alarm system was recommended	Fire alarm system installed in 2015. Region staff examining the feasibility of a fire suppression system (e.g. sprinklers). Timeline for installation set at 2020 or 2021.	No change.	The fire alarm and fire suppression systems will be installed as part of the proposed major rehabilitation.
Lightning arrestor recommended.			Lightning arrestor will be installed as part of major rehabilitation work.

Structural Measurements / Analysis / Strengthening

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Strengthening of the overall structural system recommended. Strengthening may include modification or replacement of the Bailey truss system, modification of the floorbeams, truing of portal frames, tightening of lateral bracing, etc.	Structural monitoring sensors installed in 2016. Sensors upgraded in 2017. Ongoing monitoring projected to extend into 2018. Strengthening program may commence in 2019.	Monitoring program providing key insights into structural behaviour. Bridge bearings determined to have an impact on the load-sharing between the old and new truss systems. Upcoming rehabilitation work anticipated to include bridge bearing repairs or replacement and repair of certain timber components.	Detailed structural analysis and evaluation indicates that 1944 Bailey truss system should be removed and replaced with a new robust steel truss or girder purpose-built to support all loads of the West Montrose Bridge. New truss or girder system can be hidden by cladding in the same manner that the Bailey trusses are currently hidden.

Cedar Shingle Roof

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Ongoing shingle maintenance and replacement recommended.	Re-shingling required. Recommended to defer this work until major rehabilitation is complete and undertake interim repairs on an as-needed basis.	No Change.	The roof will be re-shingled as part of the proposed major rehabilitation.

Interior / Exterior Cladding

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Ongoing cladding maintenance and replacement recommended.	Recommended to defer this work until major rehabilitation is complete and undertake interim repairs on an as-needed basis.	No Change.	The cladding will be fully replaced as part of the proposed major rehabilitation.

Illumination

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Recommended improved lighting in the bridge to increase safety and deter vandalism.	Bridge re-wiring completed in 2016. Preferred luminaire identified in 2017 and reviewed by Heritage committees at Woolwich Township, and the Region of Waterloo, and also WMRA. Installation planned for 2018.	Upgraded illumination installed in 2018.	The upgraded illumination will be maintained as part of the proposed major rehabilitation works.

General Maintenance

2014 Preservation Plan	2017 Update	2018 Update	2020 Update
Recommended ongoing maintenance including: ▪ Cleaning ▪ Washing ▪ Fire alarm testing ▪ Removal of animal waste ▪ Deck sweeping	Dry ice blasting to clean inside bridge undertaken in 2014. Ongoing activities: ▪ Sweeping of deck. ▪ General cleaning. ▪ Power washing	Regular sweeping, cleaning and power washing to continue.	Regular sweeping, cleaning and power washing to continue until rehabilitation commences. Ongoing Maintenance Plan to be updated upon completion of rehabilitation.

Appendix D

Proposed Rehabilitation Concept



Figure D1: Proposed Rehabilitation Concept



Figure D2: Proposed Rehabilitation Concept