West Montrose Covered Bridge Rehabilitation

Public Consultation #3







Township of Woolwich, Region of Waterloo

November 2023

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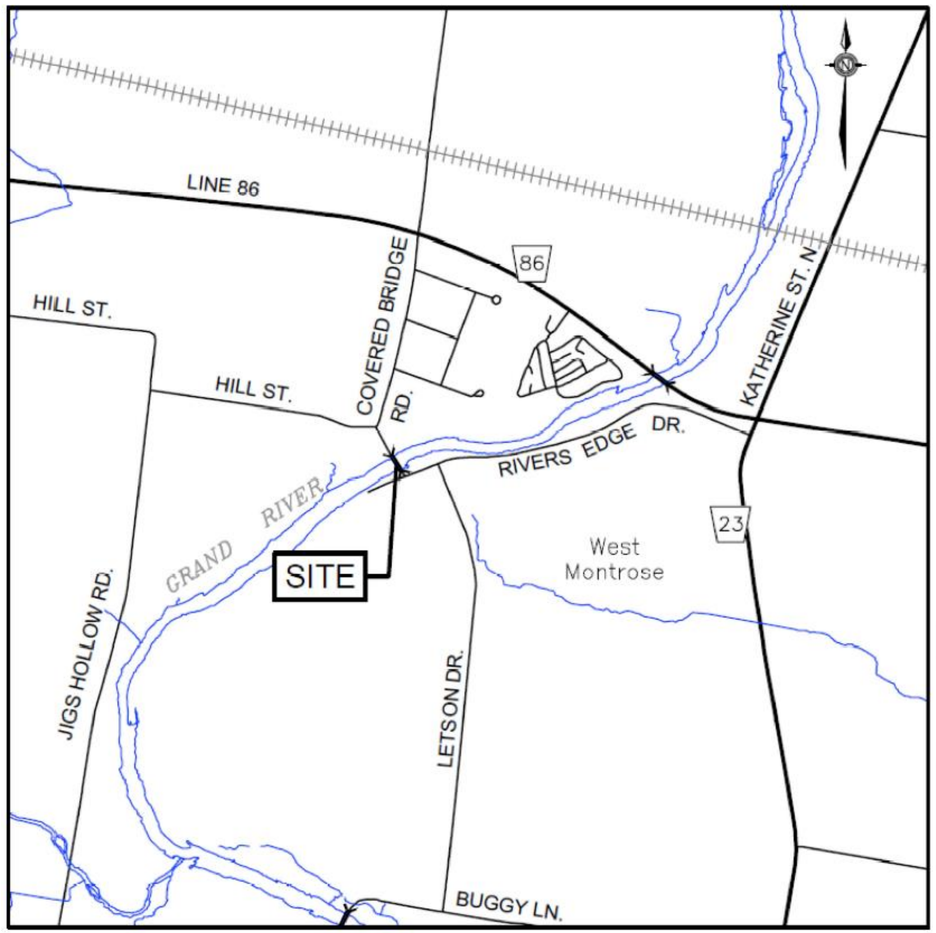
Study Introduction

Project Purpose

The West Montrose Covered Bridge requires a complete structural rehabilitation to ensure the structure will continue to serve the public through the current century.

This study follows the Municipal Class Environmental Assessment (EA) process and is classified as a Schedule C Project.

Project Location



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Project Need and Opportunities

The 2014 Preservation Strategy for the West Montrose Covered Bridge and ongoing structural monitoring of the bridge has identified the need to:

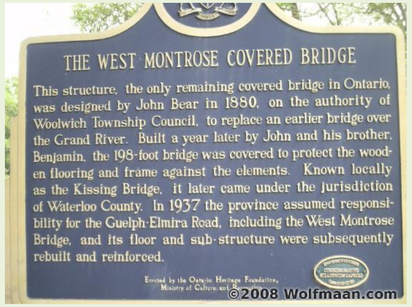
- Remove the Bailey truss system and provide a single robust load bearing system capable of supporting all loads on the bridge.
- Repair the roof and exterior cladding.
- Mitigate other risk factors to the bridge including damage by oversize vehicles, loss by fire, flooding, ice and/or snow damage.

Structural Rehabilitation



Strengthen the overall structural system to support bridge loads and ensure public safety

Heritage Conservation



Preserve the heritage designation of the bridge

Ongoing Maintenance



Minimize future maintenance requirements

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Existing Challenges



Natural risks (wind, flood, snow, and ice damage)



Overloading of the bridge by oversize vehicles



Risk of Vandalism



Water supply for a fire suppression system



Deterioration of the timber truss, with time



Protection of the wooden truss

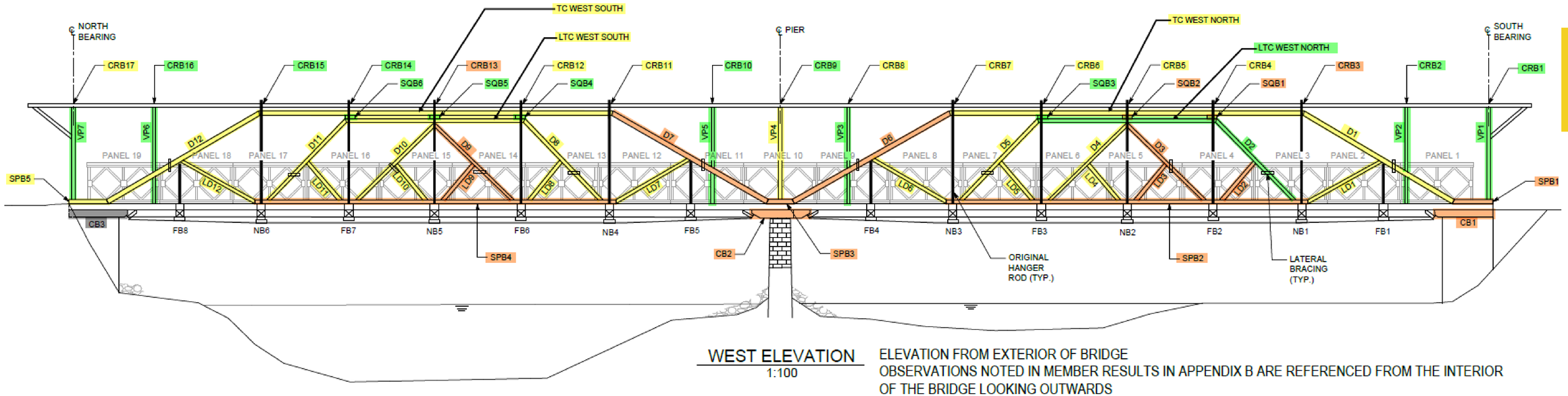
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Background Studies

Study	Considerations
Natural Environment Study	Potential impacts on terrestrial species, vegetation, birds, amphibians, bat habitat, aquatic habitat, and fish
Stage 1 Archaeological Assessment	Potential impacts on sites with archaeological potential
Heritage Impact Assessment	Cultural heritage conservation of the bridge
Hydraulic Assessment	Assessment of flood water levels and scour
Geotechnical Study	Composition of the pier, abutments and the underlying soil

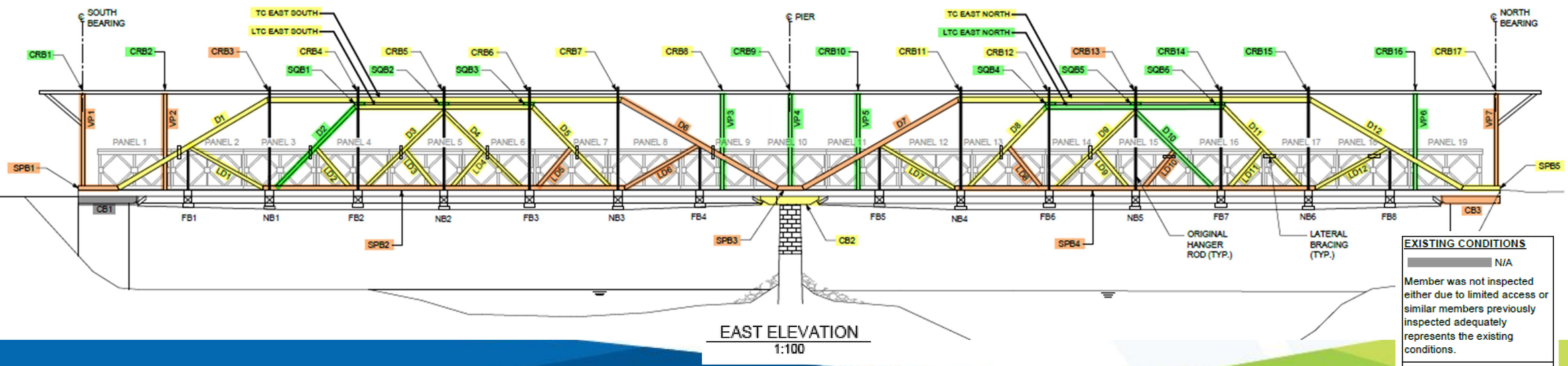
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Background Studies – Timber Truss Assessment



WEST ELEVATION
1:100

ELEVATION FROM EXTERIOR OF BRIDGE
OBSERVATIONS NOTED IN MEMBER RESULTS IN APPENDIX B ARE REFERENCED FROM THE INTERIOR OF THE BRIDGE LOOKING OUTWARDS



EAST ELEVATION
1:100

EXISTING CONDITIONS

N/A
Member was not inspected either due to limited access or similar members previously inspected adequately represents the existing conditions.

POOR
Severe deterioration.

FAIR
Minor deterioration. Member is still serviceable.

GOOD
No comments from visual review and resistograph readings. Expected MC%.

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Background Studies – Existing Wooden Truss Conditions

Elements recommended for replacement **based on condition**:

- Roof shingles
- Exterior red cladding
- Deck
- Stringers
- Floor beams and needle beams
- Bottom chord
- Steel hanger rods
- Sway bracing
- Bottom lateral bracing
- End diagonals at the pier
- Replace the following items as necessary:
  - Tie beams
  - Squash blocks
  - Vertical posts
  - Roof sheathing and rafters











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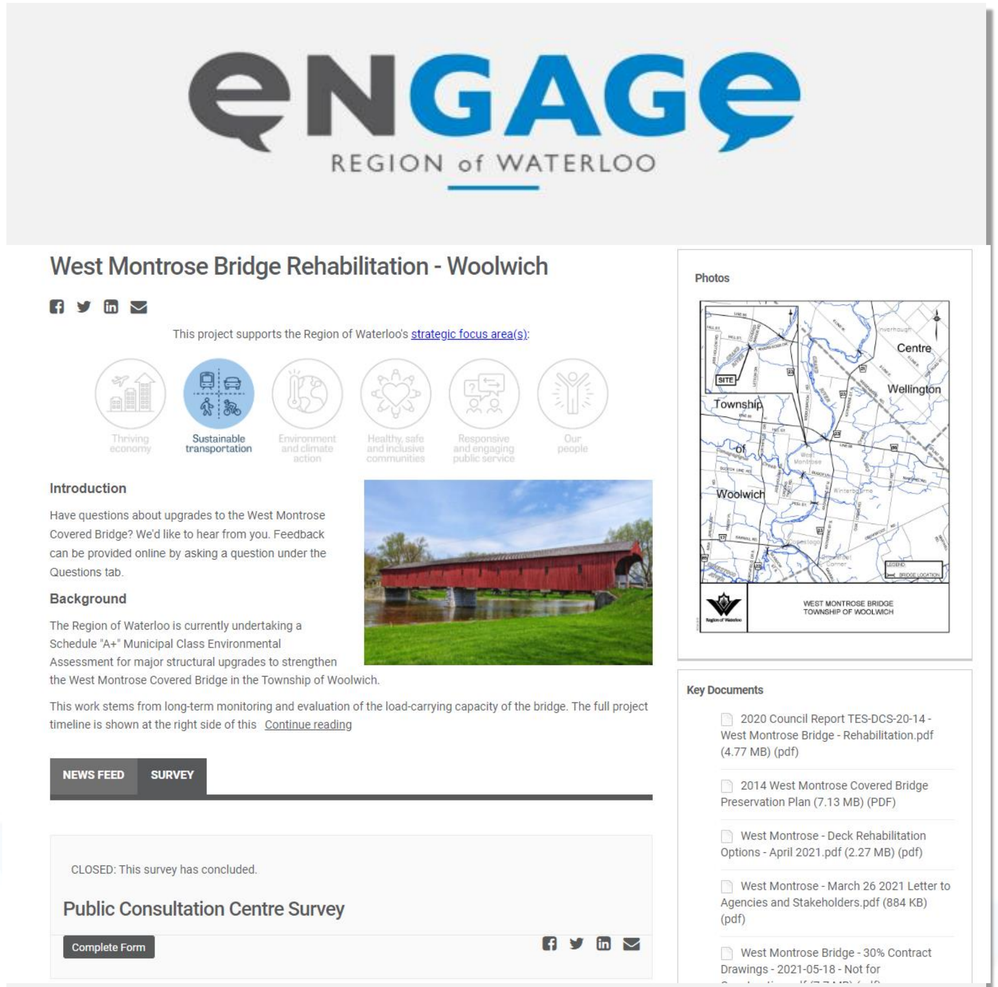
Public Consultation Centre #1
October 2021

- 36 Surveys and comments received

Public Consultation Centre #2
June 2022

- 51 Surveys and comments received **t**hrough EngageWR website and email

Public Consultation Centre #3
November 2023



- Public Consultation Centre #1 and #2 were hosted on the Region's EngageWR Website
- Participants were encouraged to complete the survey, submit questions via the Question and Answer (Q&A) page, submit comment forms / emails and Contact the project team

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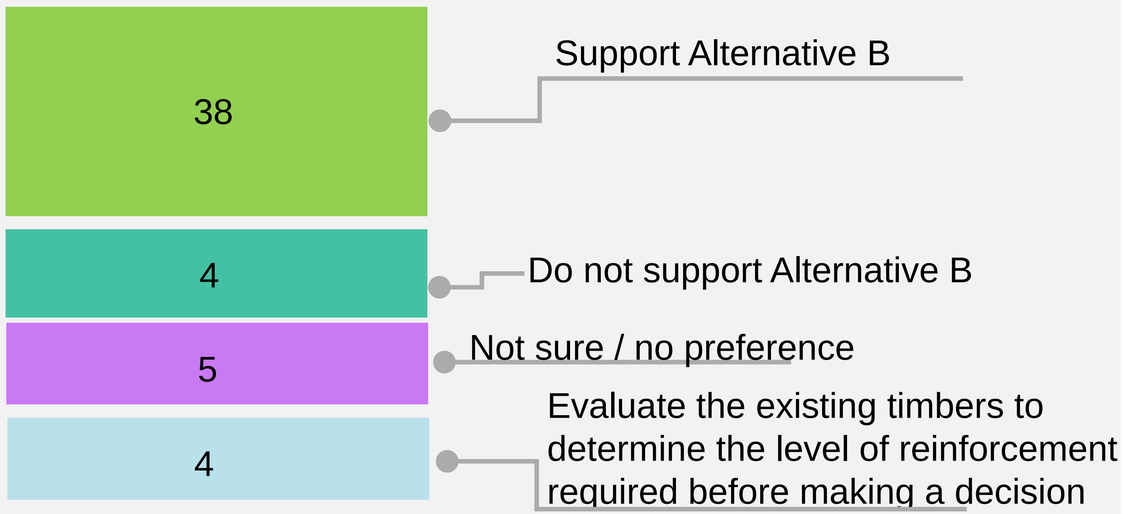
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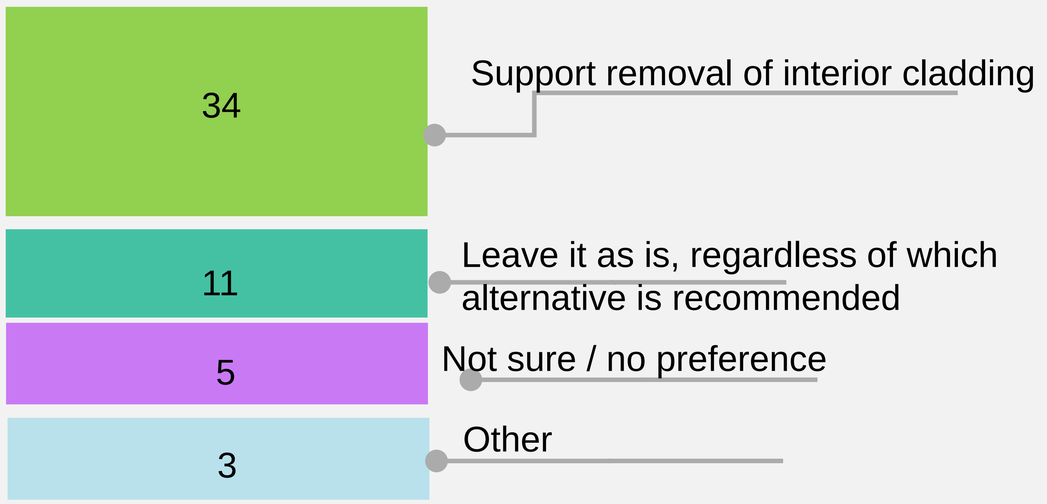
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Public Consultation Centre #2 – June 2022

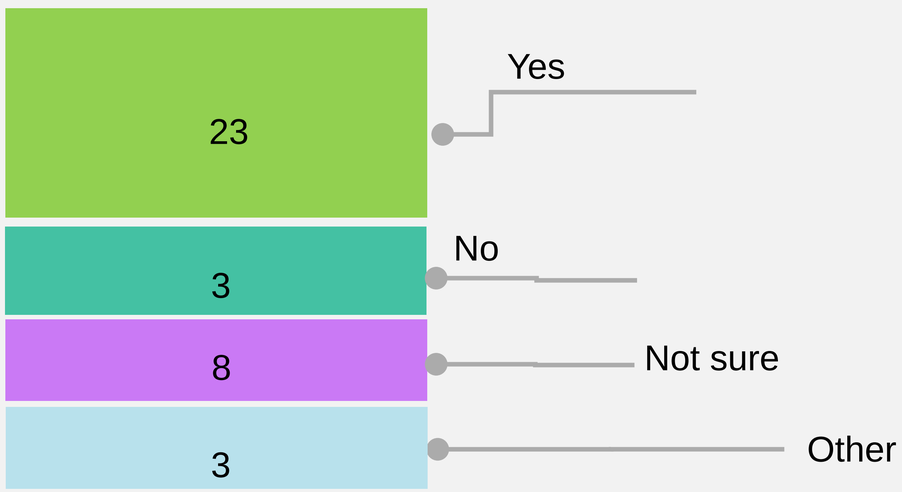
Support for Alternative B – Timber Truss Reinforcement



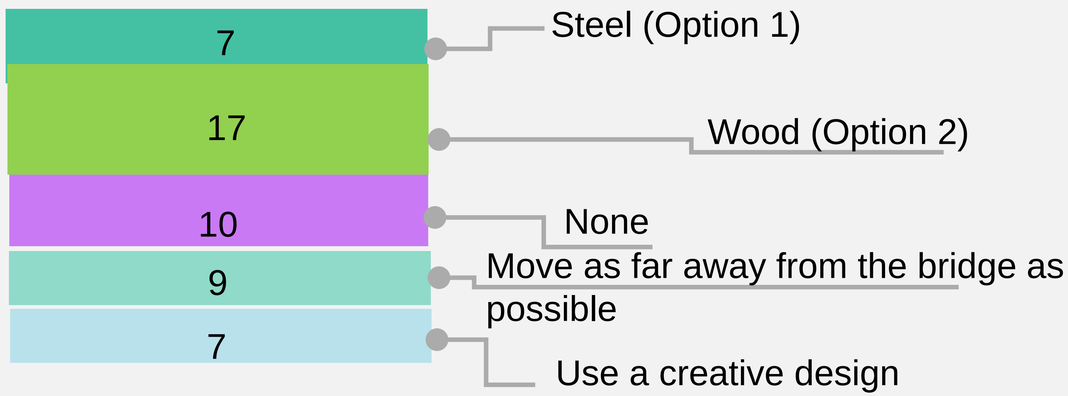
Support for removal of Interior White Cladding



Support Physical Roadside Features to Restrict Oversized Vehicles (PCC#1)



Physical Height Restriction Bar Options



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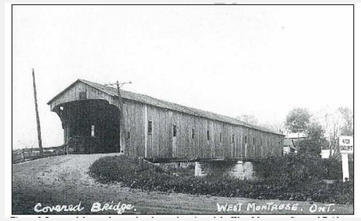
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Public Consultation Centre #2 – Community Priorities



Engage an expert in historic timber bridge restorations to evaluate the existing timbers to determine the level of reinforcement required



Restore the bridge to the way it was built in 1881



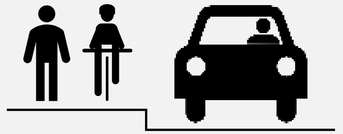
Reuse as much of the existing wood as possible



Dislikes look of truss reinforcements and/or raising the height of the bridge



Bridge capacity and load limit (posted and design)



Provide traffic calming for horse & buggies on Line 86

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Proposed Rehabilitation – Common to All Alternatives

Existing

Post rehabilitation



1. Bridge sag reduced
2. Replace roof with new cedar shingles
3. Replace exterior wood cladding
4. Replace window louvres

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Proposed Rehabilitation – Common to All Alternatives



5 Remove steel Bailey truss

6 Re-instate tar and chip wearing surface after replacement of nail-laminated deck

7 Replace steel hanger rods

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8 Replace rafters as necessary

9 Replace tie beams as necessary

10 Replace wood curbs

11 Replace light bulbs as necessary

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12 Replace needle beams

13 Replace floor beams

14 Repairs to center pier

15 Replace sway bracing

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Proposed Rehabilitation – Common to All Alternatives



16 Replace stringers

17 Replace nail-laminated deck

18 Remove Bailey truss hanger system

19 Remove non-functioning tension rods (1959)

20 Replace Bottom lateral bracing

21 Replace bottom chord

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Proposed Rehabilitation – Common to All Alternatives

22) Concrete repairs to bridge abutments

23) Bridge deck elevation and approach grades will remain the same

24) Height restriction bars to prevent oversized vehicles from using the bridge

25) Fire retardant materials applied to various bridge elements

3 tonne posted load limit to be maintained



✓ Small Cars, SUVs, Horse & Buggies	1 - 3 tonnes
✓ ✗ Pick-up Trucks	1.7 – 3.5 tonnes
✗ EMS Vehicles	4 - 8 tonnes
✗ School Bus/Small Truck	6 - 12 tonnes
✗ Large truck	13+ tonnes

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Rehabilitation Alternatives

The following alternatives were evaluated by the Project Team:

Alternative	Description
A	Steel Girder Reinforcement Presented at Public Consultation #1 and #2
B	Timber Truss Reinforcement with Fiber Reinforced Polymer (FRP) Presented at Public Consultation #2 as the Preferred Alternative
C1 to C4	Repairs to wooden truss members to achieve a design vehicular live load limit of:
C1	12 tonnes
C2 (Preferred)	**10 tonnes**
C3	8 tonnes
C4	6 tonnes

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Alternative A – Steel Girder Reinforcement

- Remove Bailey trusses and replace with new steel girders
- New steel girders would be the primary structural system
- Replace interior white cladding
- Bridge interior would look similar to the way it looks today
- Width of driving lane would become slightly more narrow
- Includes new steel floor beams
- Can accommodate a design live load of approximately 15 tonnes





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Alternative B – Timber Truss Reinforcement with Fibre-reinforced Polymer (FRP)

- Remove Bailey truss and strengthen the existing wooden truss with high-strength fibre reinforcement attached to the bottom chord
- Reinforce deteriorated truss members
- Remove interior white cladding
- Install timber guardrail to protect wooden truss
- FRP bonding to the bottom chord of the truss was determined to be **unsuitable** due to the deteriorated condition of the bottom chord discovered during the timber inspection. The bottom chord is recommended for replacement.







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Alternatives C1 to C4 – Wood Repairs

- Remove existing steel Bailey truss and repair/replace deteriorated wooden truss members
- Level of intervention to various truss members varies based on the design live load, as outlined in the table below
- Remove interior white cladding and reinstate in small sections at each end
- Install overhead lateral bracing inside the bridge

Truss Element	Alt. C1 – 12 tonnes	Alt. C2 - 10 tonnes (Preferred)	Alt. C3 - 8 tonnes	Alt. C4 - 6 tonnes
Stringers	Replace with new sawn wood stringers			
Floor and Needle Beams	Replace with new 16" x 16" sawn wood Douglas Fir beams. The current beams are 12" x 12".			
Bottom Chord	Replace with new Douglas Fir chord			
Top Chord	No action			
Lower Top Chord	Make composite with top chord by adding wood plate between top chord and lower top chord and fastening together			No action
End Diagonals	Repair by fastening on new 4 1/2" (102mm) thick wood plank	Repair by fastening on new 4" (89mm) thick wood plank	Repair by fastening on new 3" (64mm) thick wood plank	
Interior Diagonals	Repair by fastening on new 2" (38mm) thick wood plank	No action		
Lower Diagonals	No action			

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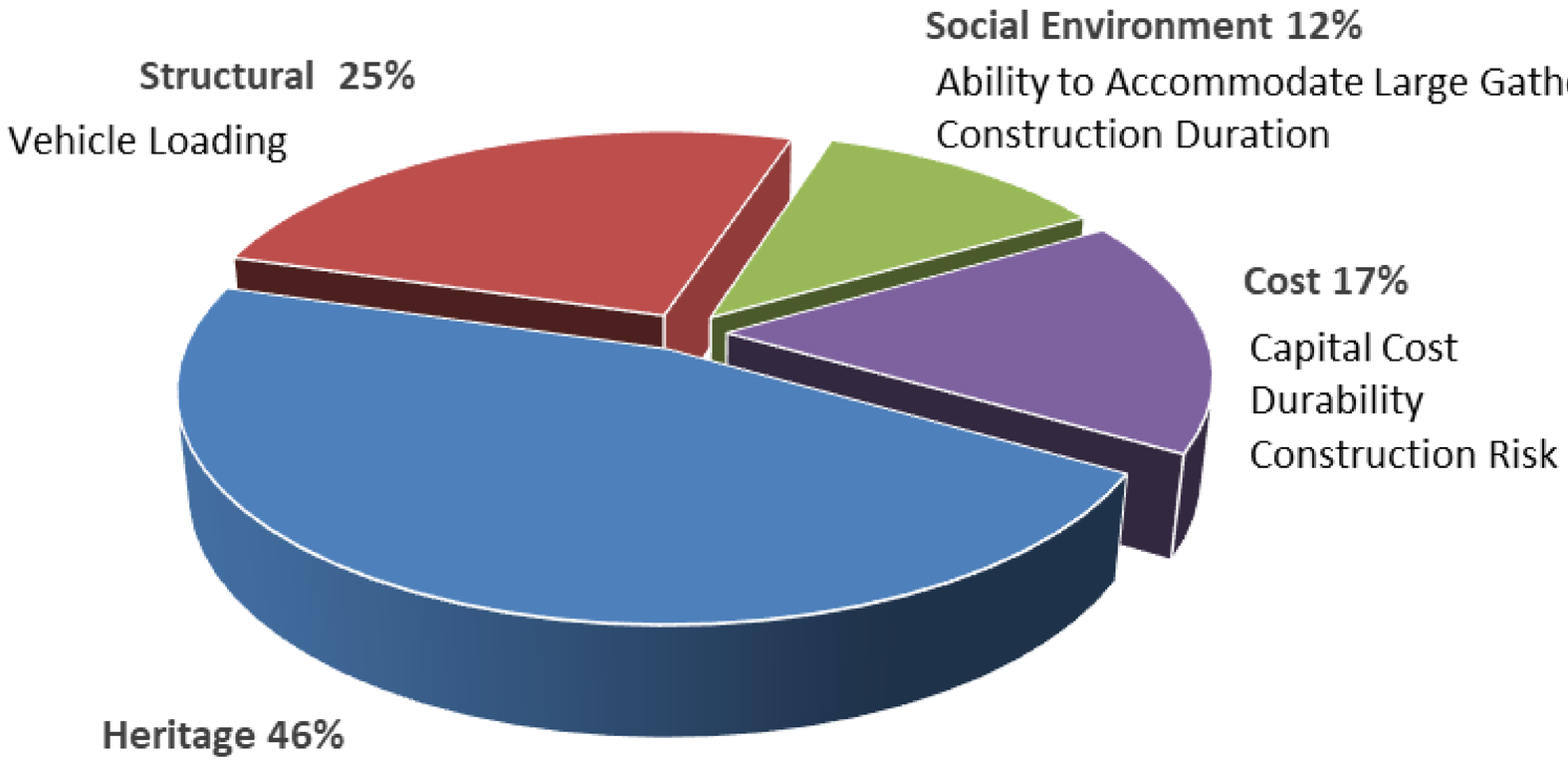
Alternatives Evaluation – Multi-Attribute Trade-off System (MATS)

- Alternatives were assessed using a comprehensive evaluation methodology referred to as the Multi Attribute Trade-off System (MATS) method.
- Four evaluation factor groups were considered: Heritage, Structural, Social Environment and Cost.
- Factor groups are made up of measurable criteria (sub-factors) used to identify relevant benefits and impacts and the relative differences between alternatives.
- The alternatives were evaluated based on the following criteria:

Criteria	Cultural Heritage	Structural Performance	Social Environment	Life-cycle Cost
Sub-Factors	• Visual Character – Reinforcing/Replacing Members • Visual Character – view to the bridge from Banks of Grand River • Retain Original Bridge Dimensions • Flexibility for Interior Cladding Dimensions • Level of Intervention (Reversibility) • Visibility of Original Truss Structure • Floor System	• Vehicle Loading	• Ability to accommodate large gatherings/ special events • Construction Duration	• Capital Cost • Durability • Constructability

Alternatives Evaluation - MATS

The criteria were assigned weightings in the evaluation by the Project Team:

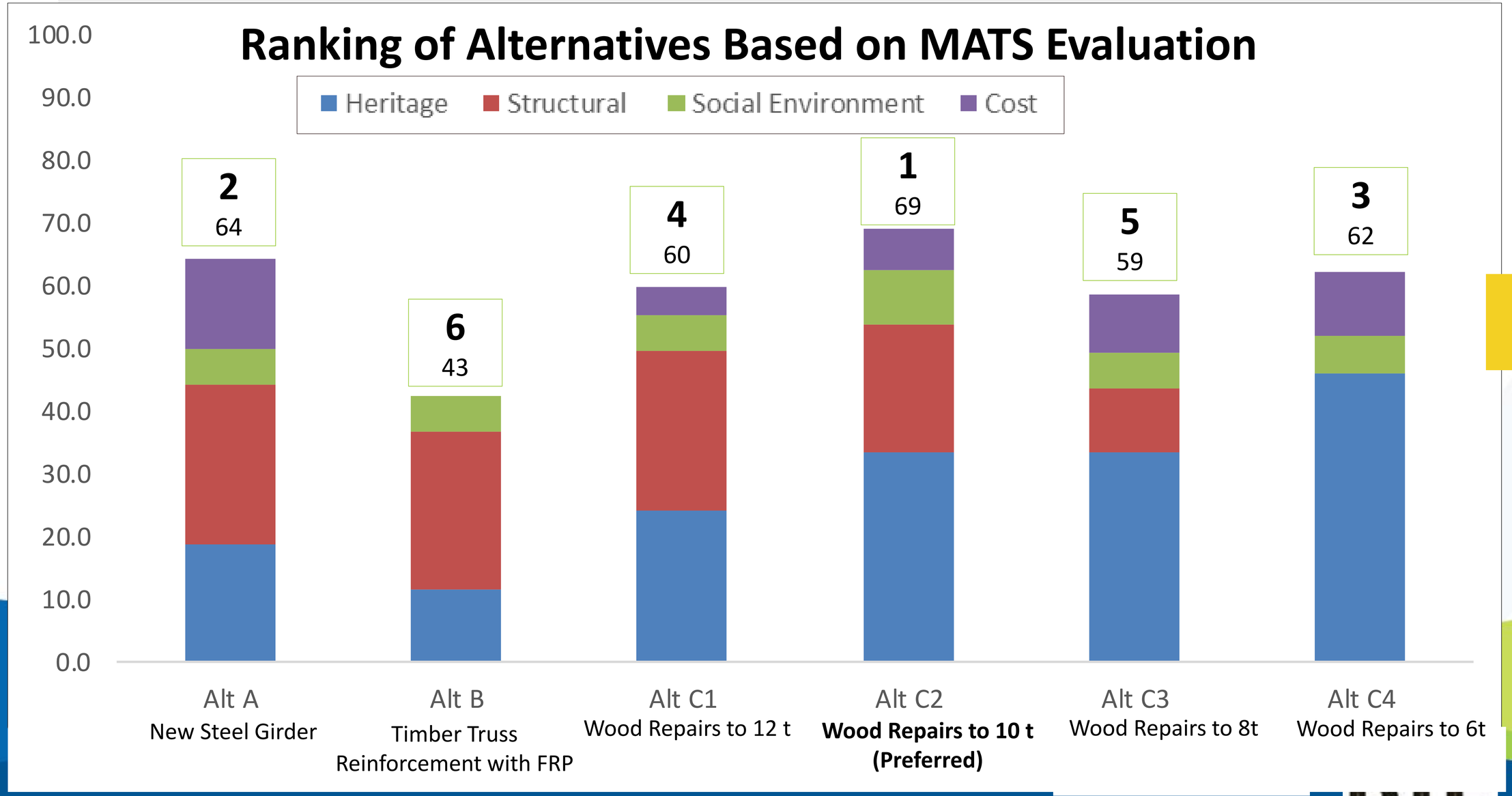


Visual Character - Reinforcing/Replacing Members
Visual Character - Views to the Bridge from Banks of Grand River
Retain Original Bridge Dimensions
Flexibility for Interior Cladding Dimensions
Level of Intervention (Reversibility)
Visibility of Original Truss Structure
Floor System

Alternatives Evaluation - MATS

Alternative scores are determined through the use of a mathematical relationship to equate impacts to scores.

The results of the MATS evaluation are illustrated on the following exhibit.



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Alternatives Evaluation – Sensitivity Testing

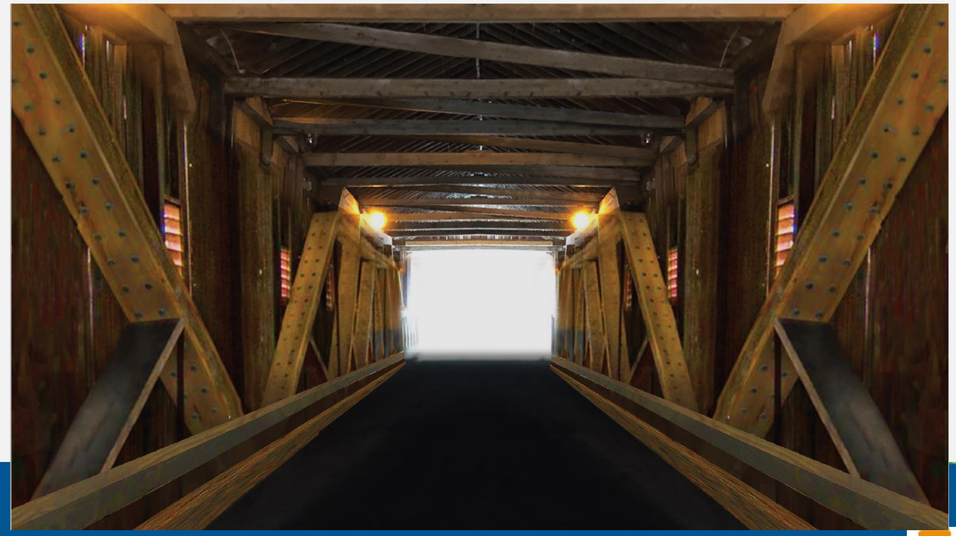
- Sensitivity testing was conducted to determine if the nature of the evaluation is sensitive to the weights assigned to each criterion.
- A series of tests were completed varying the weight for each global factor.
- Following this series of tests, the results were reviewed to assess whether the preferred alternative changed when the weights were varied.
- The results of the sensitivity test illustrate the trade-offs of the structural and heritage characteristics of the alternatives.
- Alternative A performs best structurally, with trade-offs for impacts to the heritage attributes. Alternative C4 performs best for the heritage attributes, but has the lowest structural loading capacity.
- Alternative C2 provides the best balanced alternative, balancing the structural loading capacity and the heritage attributes of the structure.

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Recommended Rehabilitation Alternative

Removal of the existing Bailey truss and strengthening of the existing wooden truss to a **10 tonne design live load**, by replacing and/or strengthening specific wooden truss members, including:

- Replace floor beams and needle beams with new 16"x16" Douglas fir beams
- Replace bottom chord with new Douglas Fir members
- Make lower top chord composite with top chord by adding wood plate between top chord and lower top chord and fastening together
- Strengthen end diagonals by fastening on new 4" (89mm) thick wood planks
- Remove interior cladding and reinstate in short sections in each corner



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Recommended Rehabilitation Alternative



12 New Douglas Fir 16"x16" needle beams

13 New Douglas Fir 16"x16" floor beams

16 New sawn wood stringers

17 New nail-laminated wood deck

20 New steel rod cross-bracing

21 New Douglas Fir bottom chord member

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- 10 New wood curbs
- 26 Replace end diagonals at pier and strengthen end diagonals at abutments
- 27 New overhead wood lateral bracing
- 28 New timber guiderail

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29 Reinforce top chord with lower top chord

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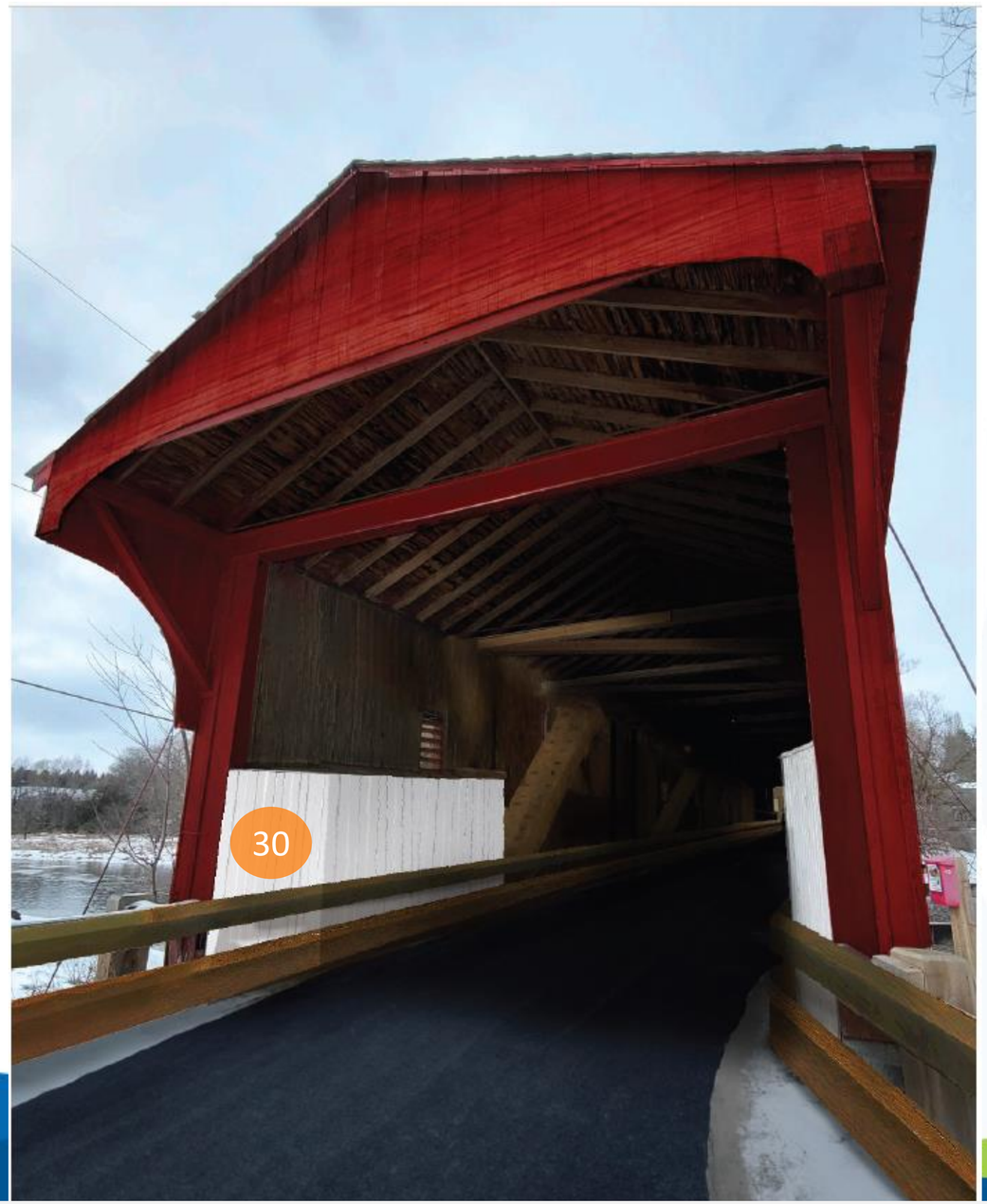
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Recommended Rehabilitation Alternative – Interior Cladding



30 Reinstate interior cladding in short sections at each end of the bridge VE

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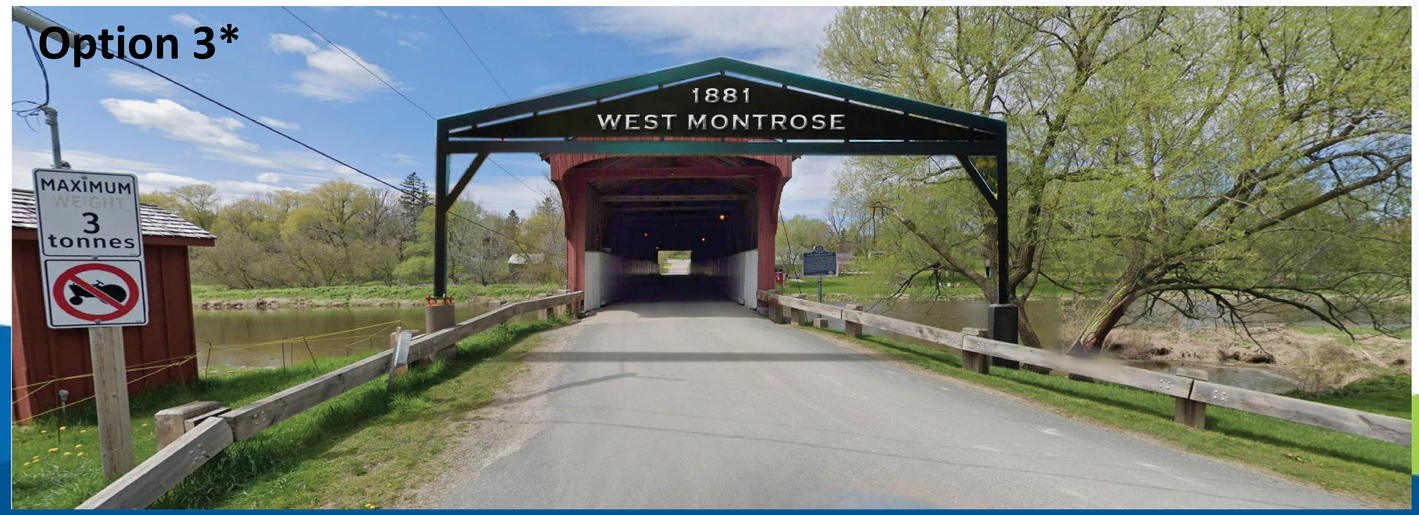
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Proposed Improvement #25 – Height Restrictor Bar Options for Public Input







*Option 3 details to be finalized with the input of an architect

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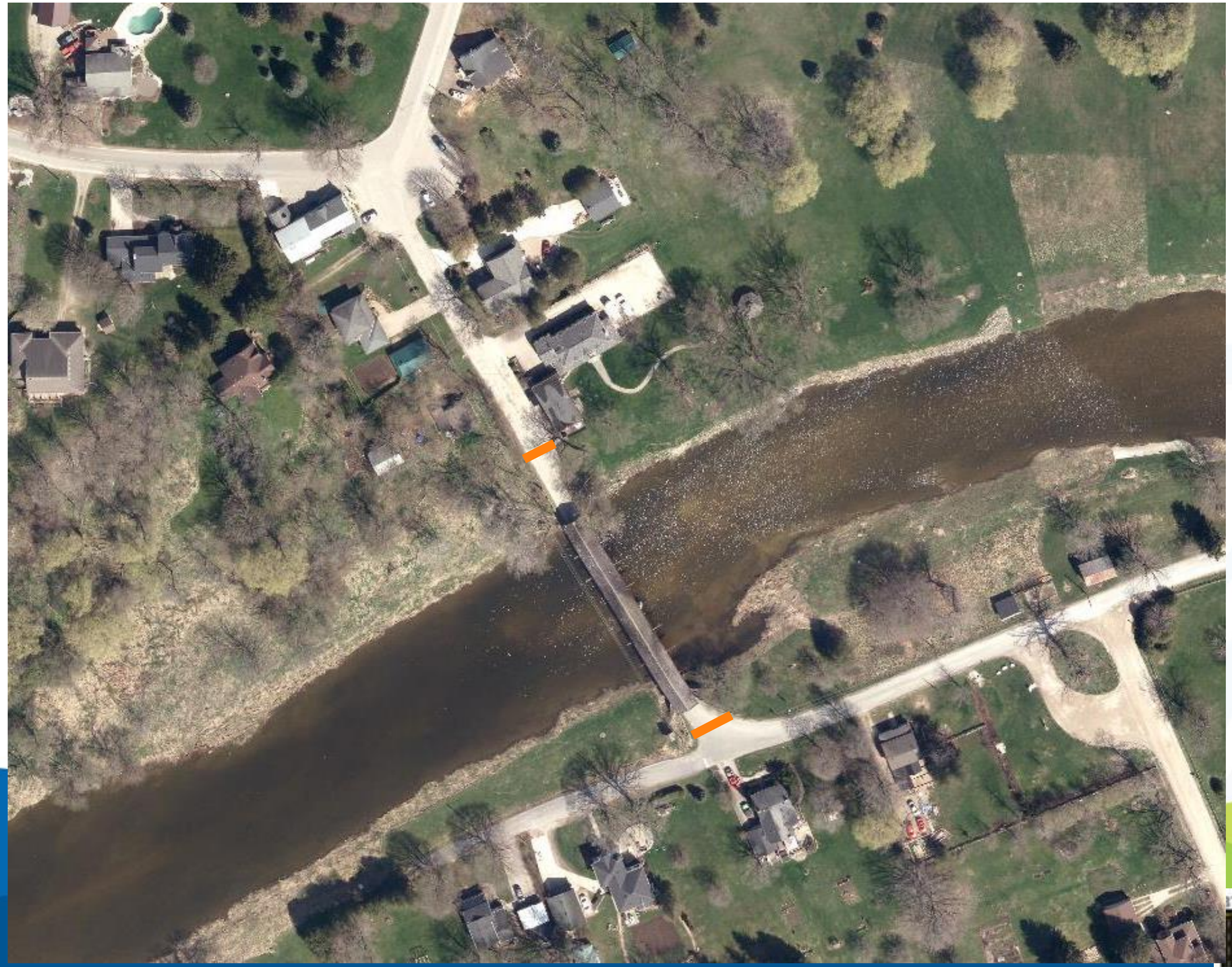
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Proposed Location of Height Restrictor Bars



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Motorized Vehicle Restriction for Public Input

- We are asking for public input on whether signage should be posted to restrict motorized vehicles from using the bridge
- Horse and buggies, pedestrians and cyclists would still be permitted across the bridge
- This would not change the recommended Preferred Alternative C2, to rehabilitate the bridge to a 10 tonne load limit





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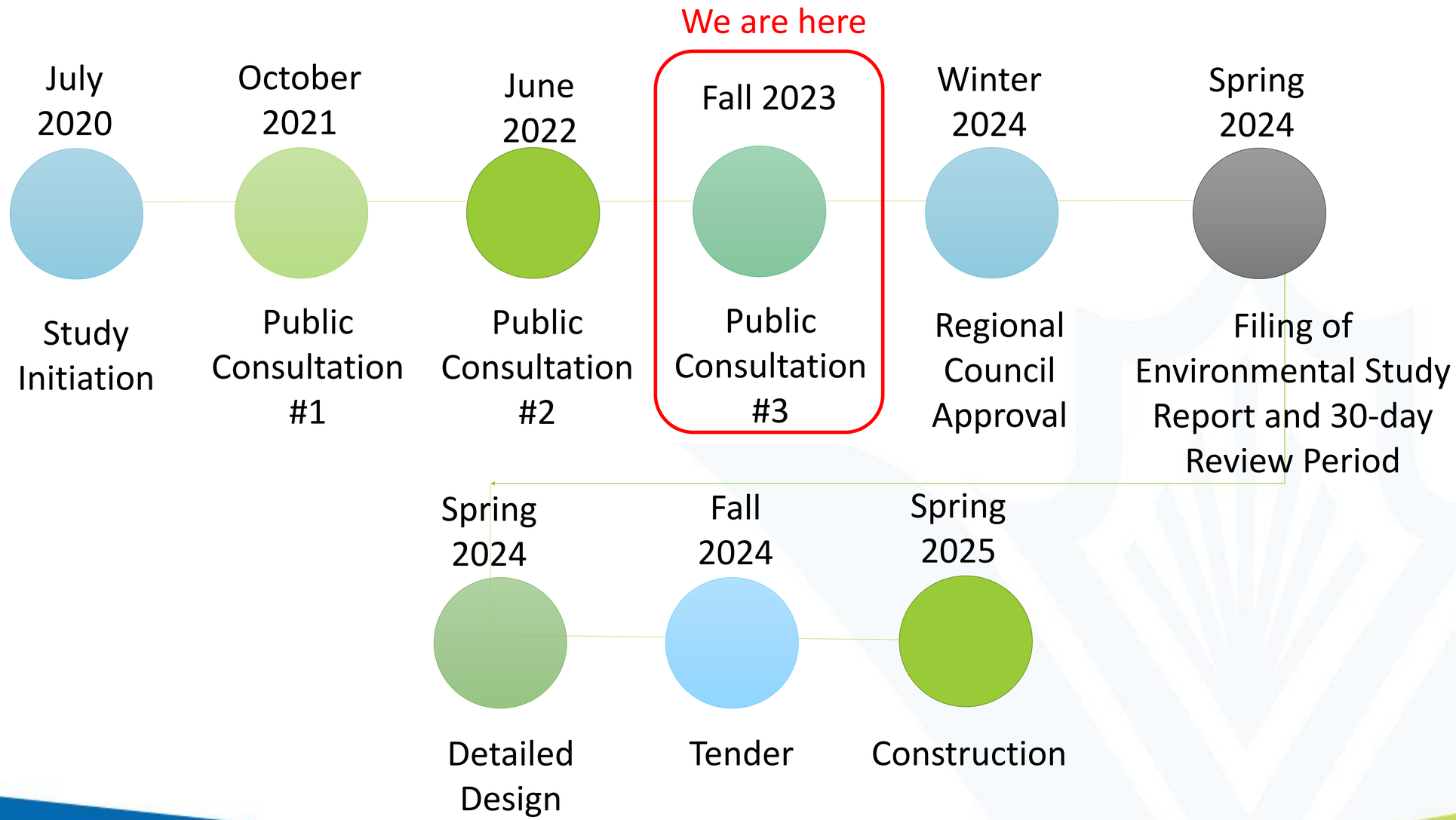
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Thank you!

Follow the project at: engagewr.ca/west-montrose

Join our mailing list and complete the survey by December 13, 2023

A public Open House is planned on **November 22, 2023** from 6:30p.m. – 9:00p.m. at the West Montrose United Church located at 42 Covered Bridge Drive, West Montrose

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