Draft Scoping Report
Lower Cox Brook Covered Bridge
Town Highway 3
Bridge 11 over Cox Brook

Northfield BO CVBR(8)

January 24, 2026

Prepared for:
Vermont Agency of Transportation

HOYLE TANNER

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Location Map

1. SITE INFORMATION

The Lower Cox Covered Bridge (Bridge No. 11) is a Town-owned bridge located on Town Highway 3 (TH-3), Cox Brook Road, just west of the intersection with Chandler Road. The bridge is a 55'-3" long single span queenpost truss which carries one lane alternating traffic over the Cox Brook near the center of the Village of Northfield Falls. Northfield Falls is an unincorporated village in the Town of Northfield, VT. The bridge is one of five covered bridges in the Town of Northfield, the second highest concentration by town of such bridges in Vermont. The sign on the west portal states that the bridge was built in 1872.

Due to its historic and national significance the bridge is currently listed on the National Register of Historic Places, a federal program that is administered by the National Park Service.

This scoping report was compiled after the review of multiple sources of data including topographic ground survey, lidar scanning, previous rehabilitation plans, VTrans Structure Inspection, Inventory and Appraisal Sheet, field measurements, and photographs taken during site visits by Hoyle Tanner personnel. The intent of this report is to evaluate structural deficiencies and to recommend a solution which best addresses the project's need. For purposes of this report, the substructure units are numbered sequentially from west to east and all members are wood unless noted otherwise.

Upstream Elevation Looking South

Roadway Classification:	Local Road, Class 2 Town Highway
Bridge Type:	Single Span Queenpost Covered Bridge
Bridge Length:	55'-3" feet
Bridge Skew:	No Skew
Year Built:	1872, Rehabilitated in 1967 and 1979
Ownership:	Town of Northfield

The bridge has undergone numerous changes or additions throughout its history with various degrees of documentation. Two major and documented rehabilitations were completed in 1967 and 1979.

The 1967 rehabilitation plans noted the work shown below. Record drawings of this rehabilitation are not available, and it is not known if all this work was completed at that time.

- Straightening and plumbing of the trusses.
- Replacing parts of the floor system, including new 2"x6" nail laminated deck and 3"x10" nailing strips, new 24WF84 steel stringers, lateral bracing, and intermediate and end diaphragms.
- Installing new bearings for all stringers.
- Applying wood preservative to flooring, blocking, and nailing strips replacement timbers.
- Facing northwest wingwall at Abutment 1 with concrete.
- Refacing Abutment 1 with concrete.
- Raising Abutment 1 backwall.
- Replacing truss bearing blocks.

- Removing and reinstalling or replacing the existing siding as required to complete the work noted above.

The 1979 rehabilitation plans noted the work shown below. Record drawings of this rehabilitation are not available, and it is not known if all this work was completed at that time.

- Clean and paint support brackets.
- Clean and paint steel stringers.
- Install new approach guardrail.
- Remove cracked concrete at south abutment and bearing caps at north abutment and replace with new concrete and steel reinforcing in both locations.
- Reinstall or replace loose or damaged siding.

East Portal Looking West

There is load restriction posted for the bridge of 12-Ton for a Single Axle, 15-Ton for a Tandem, and 21-Ton Gross weight. The bridge provides a horizontal clearance of 15'-5" between the trusses and 12'-11" maximum vertical clearance, with vertical clearance at the edges of the travel lane of approximately 10'-3". The vertical clearance signs on each approach to the bridge indicate a height restriction of 12'-0".

Cox Brook Road (TH-3) is oriented in a west to east direction within the project limits. Horse Lane is located to the west of the bridge and Chandler Road is located to the east. Horse Lane (TH-87) and Chandler Road (TH-13) are oriented north to south. The Lower Cox Covered Bridge is located 0.1 miles west of the intersection of Cox Brook Road and VT Route 12.

Tangent weathering steel w-beam guardrail is used at all four approaches to the bridge. There are no crashworthy end units on the guardrail. Side slopes are generally level off the roadway except in the vicinity of the bridge. The west approach to the bridge intersects with Horse Lane approximately 200' west of the bridge. There is a gravel drive directly east of the bridge. There is no curbing on any of the approaches to the bridge. The approach grades to the bridge are mostly flat and stormwater generally sheet flows off the roadway.

a. Need

The Lower Cox Covered Bridge was last inspected by VTrans personnel on August 20, 2024. Hoyle Tanner personnel also inspected the bridge and performed in-depth field measurements and gathered field data for this Scoping Study on November 7 and 11, 2023. The bridge (superstructure, deck, substructure) is considered to be in poor condition, and several deficiencies have been noted. The following is a list of deficiencies of Bridge No. 11 and TH-3 at this location:

Private Drive at East Approach

<u>Roof and Siding Members:</u>

- Metal roof is in fair condition.
- There are rusting and leaks due to failing screw attachments of the metal roofing to the roof boards.

- The roofboards and rafters exhibit through splits, breaks, insect damage, and rot. It is estimated that all of the roofboards and 8% of the roof rafters will require replacement due to condition.
- The siding boards are in good condition; however, removal and replacement will likely be required to provide access for the extensive truss member replacements.

Upper Lateral Bracing Members:

- The upper lateral bracing members exhibit splits, breaks, rot, and impact damage.
- The crossbeams have been hit by vehicles, causing impact damage and breaking the connection between the crossbeams and knee braces.
- The knee braces have been damaged from oversized vehicles, and some are not connected to the crossbeams or truss members.

Truss Chord Members:

- Trusses members exhibit splits, breaks, rot, and high moisture content. Refer to Appendix E for deteriorated chord members that were identified in need of replacement due to condition.
- Several nailers and vertical members have loose connections.
- Bottom chord at the end of the south truss exhibits extensive rot, heavy weathering, and checking. The bottom chord has a split and has been repaired used a steel plate. Refer to Appendix E for deteriorated chord members that were identified in need of replacement due to condition.
- The moisture content of the truss members was measured to be a maximum of 50% in the lower portions of the trusses.
- Debris and dirt accumulates near the bearings between the truss and the siding.

Floor System Members:

- The steel beams have areas of heavy lamination and areas of section losses up to ⅜" on the bottom flange, ¼" along the top flange, and ⅛" along the web.
- There are several locations where the section loss was 100% on the diaphragms.
- The runner boards are comprised of 1⅝" thick boards. They exhibit areas of moderate to heavy wear, rutting and splits.
- The deck is comprised of 2"x6" nail laminated timber and is in fair condition; however, removal and replacement will likely be required to provide access for the extensive floor member replacements.

Truss Bearing Blocks:

- The wooden bearing blocks exhibit heavy rot and decay at each end of the bridge.

Substructure:

- Both abutments exhibit areas of concrete spalling, delamination, efflorescence staining, vertical, horizontal and map cracking.

General:

- The bridge lacks fire protection.
- The vertical clearance is substandard and there is evidence of vehicular damage at each portal.

b. Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2029 and 2049.

Traffic Data	2029	2049
AADT	886	957
DHV	130	130
ADTT	64	82
%T	6.1%	7.2%
%D	50%	50%

c. Design Criteria

The design standards for this bridge project are the Vermont State Design Standards (VSDS), dated October 22, 1997. Minimum standards are based on an ADT of 957, a DHV of 130, and a design speed of 35 mph for a Local Road.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSDS Table 6.3	9'/2' (22')	9'/2' (22')	
Bridge Lane and Shoulder Widths	VSDS Table 6.3	15'-5" Between Trusses/0' (15.5')	9'/2' (22')	Substandard
Clear Zone Distance	VSDS Table 6.5	Varies (No Issues Noted)	12' Fill / 10' Cut	
Banking	VSDS Section 6.12	NC	Low Speed Road – No Super Elevation Required	
Speed	VSDS Section 6.2	25 mph (Signed)	35 mph (Design)	Substandard
Horizontal Alignment	AASHTO Green Book, Table 3.10	R = ∞ over bridge	At e_{max} = 8%: super = 8%, R_{min} = 314' NC, R_{min} = 614'	
Vertical Grade	VSDS Table 6.6	3.7% over bridge	7% (Max) for Level Terrain	
K Values for Vertical Curves	VSDS Table 6.1	No Vertical Curve over Bridge Approach K = 21 Min	40 Crest / 50 Sag	Substandard
Vertical Clearance	VSDS Section 6.7	12'-11" Vertical Clearance Provided	14'-3"	Substandard
Stopping Sight Distance	VSDS Table 6.1	200'	225'	Substandard
Bicycle/Pedestrian Criteria	VSDS Table 6.7	No Shoulders	1' Paved Shoulder	Substandard

Hydraulics	VTrans Hydraulics Manual, Table 6.1	Passes 4% AEP (Q_{25}) storm event with X' of freeboard Clear Span: 44'-0"	Pass 4% AEP (Q_{25}) Storm Event with 1' of Freeboard Bank Full: X'	Surpasses Hydraulic Standards
Structural Capacity	Structures Design Manual, Ch. 3.4.1	Posted: Single Axle = 12 Tons Tandem = 15 Tons Gross = 21 Tons	Design Live Load: HL-93	Substandard

d. VTrans Inspection Report Summary

The ratings provided below are from the most recent inspection performed by VTrans in August 2024. The bridge is on a 24-month inspection frequency.

Deck Rating:	6 Satisfactory
Superstructure Rating:	5 Fair
Substructure Rating:	6 Satisfactory
Channel Rating:	7 Good

From the Structure Inspection, Inventory and Appraisal Sheet:

This structure should be considered for a paint project with extensive cleaning of the beams. Steel repairs are needed as well as channel beam diaphragms have extensive section loss and some members have failed. Further section loss in the abutment beam ends will result in more steel repairs or full replacement.

e. Hoyle Tanner Field Observations

On November 7 and 11, 2023 a four-person inspection team from Hoyle Tanner visited the covered bridge to perform in-depth field measurements and gather field data for this Scoping Report. The roof framing members, upper lateral bracing, truss members above the deck, interior of the siding, and deck were inspected using extension and folding ladders. The underside of the deck, truss members below the bridge deck, and steel stringers were inspected using rope access. Field observations were used as a basis for this report and expanded as appropriate. Lumber dimensions referenced throughout this report are nominal unless otherwise noted.

Several small wood samples were removed from the bridge for the purpose of species identification (see Appendix D).

Bridge Orientation Conventions

The truss upper chord is referred as the top chord and the lower chord is referred to as the bottom chord. The bottom chord consists of two plies, which are denoted as plies "A" and "B". Ply "A" is the most exterior ply while ply "B" is the most interior ply. The node points are numbered from west to east with the western most node point designated as 1 at the western most end post member. Each consecutive node number is numbered in ascending order at each intersection of vertical members to the top chord.

i. Roof Framing and Siding

The roof framing consists of a standing seam metal roof on 1" (assumed) thick roof boards with variable width which are supported by roof rafters. The roof rafters are 2" wide x 6" deep and are spaced at 2'-0½" on center and supported on a rafter support beam that is 2" deep x 6" wide. The siding is ⅞" thick (actual dimension) and is nailed to nailers attached to truss members.

The siding boards were not tested but assumed to be Eastern Spruce. The roof board wood species were also not tested but assumed to be Eastern Spruce and assigned a grade of Common Premium. The roof rafters were identified to be Eastern Spruce and assigned a grade of Select Structural. The grades were selected for structural analysis based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

Metal Roof

Splits and Breaks in Roof Boards and Rafters

The roof framing is generally considered to be in fair to satisfactory condition with the following deficiencies noted:

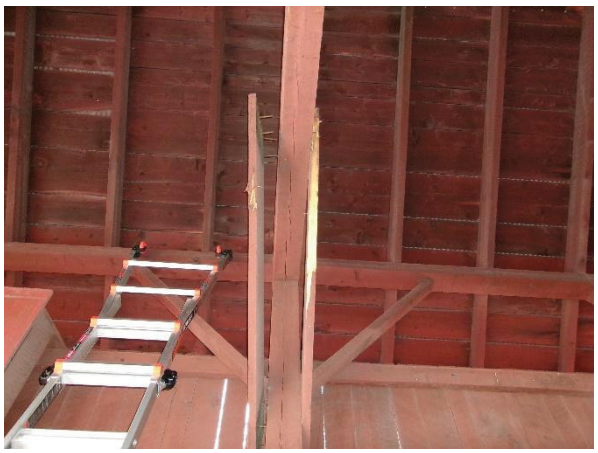
- The metal roof is attached with nails, which allow water penetrations to underlying members.
- The roof boards and rafters exhibit through splits, breaks, insect damage, and rot. Rafters sit on two 2”x6” rafter support beams.
- The siding boards exhibit areas of faded paint. The siding is in good condition; however, removal and replacement will likely be required to provide access for the extensive truss member replacements.

ii. Upper Lateral Bracing

The upper bracing consists of a mixture of 6”x6” and 6”x8” crossbeams spaced at each truss vertical, which varies in spacing from 5’-0” to 9’-6”, 2”x8” diagonal bracing between crossbeams between Nodes 1E&2W, 2W&3E, and timber knee braces. Four nails connect the knee braces to the crossbeams.

The upper bracing wood species were identified to be Eastern Spruce and assigned a grade of Select Structural based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood. The knee braces wood species were identified to be Hemlock.

Split in Crossbeam



Broken Connection at Crossbeam and Knee Brace

The upper lateral bracing members are generally considered to be in fair to satisfactory condition with the following deficiencies noted:

- Two crossbeams are split and show signs of impact damage. The cross beam at the south portal is broken.
- Crossbeams have been previously damaged from oversized vehicles and are not well connected to the vertical truss members.
- Some of the timber knee braces on the west truss have impact damage and splits.

iii. Trusses

North Queenpost Truss

The queenpost truss has a central panel that is comprised of two chords (a single top and single, longer bottom chord), which are connected outside of the queenpost vertical members by diagonal members. The bottom chord members have multiple splices along their length. Most of the steel connectors at splices exhibit rusting and section losses.

The top chord is 16'-9" long and the bottom chord is 56'-0" long and support a roof length of approximately 56'-0". The clear span from face of west abutment to face of east abutment is approximately 50' long. Top chord truss members consist of one beam, 7¾"x9¾", and built-up lower chords consisting of two 5¾"x10" plies. Truss diagonal members consist of single timber beams varying in size from 7¾"x10" to 8"x10". Interior truss vertical members vary in size and consist of 5⅝"x7⅞" to 7⅞"x9⅝" single timber columns. Exterior truss vertical members consist of 3⅜"x5⅞" and 5⅞"x6" timber columns.

The truss chord members' wood species were identified to be Eastern Spruce except for the Truss Verticals at Nodes 3 and 5 which were identified to be Hard Maple. All truss members have been assigned a grade of Select Structural for the structural analysis based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

The truss members are generally considered to be in poor condition with the following deficiencies noted:

Top Chord Members:

- The top chord of the east truss exhibited checking at both connections to the queenpost verticals. The top chord is twisted at the connection to the queenpost vertical at node 5.
- The top chord of the west truss is twisted at the entire length between the queen posts at nodes 3 and 5.

Bottom Chord Members:

- There were no deficiencies noted at the time of inspection at bottom chord of the north truss.
- There is checking in the bottom chord of the south truss between nodes 5 and 6.
- There is a large gap of 2½" in Ply A of the bottom chord of the south truss at the splice location. Ply B is broken at the splice location, and the broken chord at Ply B has been repaired with an L-shaped steel plate and several bolts connecting both sides.

South Truss Splice at Bottom Chord

Diagonal Members:

- The southeast diagonal has a 4" deep check at the end near the connection to the bottom chord.

Vertical Members:

- The interior verticals in the south truss are out of plane up to 1½" over 2'.
- There is insect damage to one of the vertical sin the north truss.
- Several of the nailers are not connected to the vertical members and are loose.
- Many of the knee braces are not connected to the vertical members and are loose.

Southeast Diagonal Check at Bottom Chord

iv. Floor System

The floor framing consists of four 24WF84 longitudinal steel beams spaced at 4'-1" on center, transverse 2"x6" nail laminated deck boards placed edgewise, and longitudinal 1⅝" thick runner planks across the entire deck. There are C15x33.9 steel diaphragms at third points along the beams and at the beams ends.

The nail laminated deck board wood species was identified to be Southern Pine. The runner planks are not shown in the 1979 plans and are assumed to be Eastern Spruce. The nail laminated deck board members have been assigned a grade of No. 1 for the structural analysis based on a visual examination of knots, checks, slope of grain of the wood, and the growth rate characteristics of the wood.

Exterior Stringer

The floor system members are generally considered to be in poor condition with the following deficiencies noted:

- The runner boards exhibit areas of moderate to heavy wear, rutting and splits.
- The deck is not well attached to the steel beams and bounces vertically when live load moves across the deck.
- The diaphragm between the northern interior and exterior beams (B3 and B4) at the east abutment has 100% section loss.
- The exterior beams had section loss that reduced flange thickness to $^{7}/_{16}$" typical, with isolated areas only ⅜" thick. The top flange also had areas of section loss with a flange thickness of ½" throughout. The webs were in fair condition with some areas of rust and section loss. By inspection, it appears the web had approximately $^{1}/_{16}$" section loss on both sides of the web.

100% Section Loss in Diaphragm

- Access was limited for the interior stringers. By inspection from the exterior beams, it appeared the interior beams had the same amount of section losses exhibited in the exterior beams.

f. Truss Bearing Blocks

The trusses sit on sleepers consisting of two 4½"x4½" timbers of varying length at each bearing location. The sleepers sit on timber blocks consisting of 3"x10" hardwood blocks with varying length that sit on CMU blocks at each end of the bridge as measured in the field.

Timber Bearing and CMU Blocks

The truss bearing blocks are in poor to serious condition with the following deficiencies noted:

- The wooden bearing blocks exhibit extensive rot and need to be replaced.
- The CMU blocks are in poor condition and need to be replaced.

g. Substructure

The bridge substructure consists of two concrete abutments. It appears the original abutments were constructed with stone masonry and encased with concrete during previous rehabilitations. The east abutment has exposed ledge in front of it, so it is likely the east abutment bears on ledge. The channel bed consists of ledge and large cobbles.

East Abutment

The west abutment is considered to be in good condition, while the east abutment is considered to be in poor condition with the following deficiencies noted:

- Both abutments exhibit some areas of concrete spalling, delamination, efflorescence staining, and vertical, horizontal, and map cracking.
- At the spalled areas the concrete was not observed to contain rebar.
- The east abutment is in poor condition and needs to be replaced.

h. Wood Species Identification

Nine small wood samples were removed from the bridge for the purpose of species identification. The samples were taken from deteriorated members that will most likely be replaced during the course of potential bridge rehabilitation or from non-critical sections of the members. To identify the wood species, the samples were sent to Doug Gardner, Ph.D., a Professor of Forest Operations, Bioproducts, and Bioenergy, at the University of Maine at Orono. A summary of the species identification can be found in Appendix D.

i. Hydraulics

The bridge crosses over the Cox Brook which flows primarily north to south at the bridge site. A hydraulic study at this location was completed on February X, 2026 by Hoyle Tanner. The preliminary findings indicate that under the current conditions, there is XX.X' and XX.X' of freeboard during the 4% (Q_{25} flood event) and 1% (Q_{100} flood event) storm event, respectively. The Q_{100} storm event is defined as a flood having a one percent (1%) chance of being met or exceeded in any given year (base flood designation Q_{100}). The Q_{25} storm event is defined as a flood having a four percent (4%) chance of being met or exceeded in any given year (base flood designation Q_{25}). The existing bridge opening has sufficient hydraulic capacity to pass the 1% storm event flow with adequate freeboard.

Upstream Channel with Exposed Bedrock

The primary purpose of the hydraulics section is to determine if the rehabilitated covered bridge is at an elevation high enough to provide adequate free board during the 100-year flood event. The existing bridge

opening has sufficient hydraulic capacity to pass the 1% storm event flow with adequate freeboard.

j. Utilities

The VTrans Utilities and Permits Unit will investigate the required relocation of existing utilities within the project limits during the design phase of project development. The existing utilities identified based on the site visit are as follows:

Aerial Utilities

- Overhead utility lines (power and telecommunication) cross Cox Brook on the downstream (south) side of the bridge.
- A service lines runs across the road at each approach to the bridge

An aerial utility relocation plan will be needed if a temporary bridge is selected for the traffic control.

k. Right-of-Way

The existing Right-Of-Way (ROW) is shown on the Layout sheet in Appendix E. It is anticipated that temporary and permanent easements will be required to construct the proposed project.

l. Resources

The biological, historic, archaeological, hazardous material and stormwater resources present at this project are shown on the Resource Site Plan Sheet in Appendix E and are based on information provided by VTrans. See Appendix E for Resource Site Plan Sheet and Appendix I for Natural Resource ID memo.

i. Biological

Wetlands/Watercourses

Lower Cox Covered Bridge crosses over the Cox Brook, a tributary of the Dog River, and a watercourse regulated by the US Army Corps of Engineers.

There are no wetlands within the review area.

Wildlife Habitat

This area has three habitat blocks surrounding the project area and ranks high for surface water riparian community connectivity and has a high priority connectivity block adjacent to it. Aquatic Organism Passage (AOP) will be prioritized by the design team.

Rare, Threatened and Endangered Species

The only listed species within the review area is the wood turtle (Glyptemys insculpta). It has not been recorded under Bridge 11, but it has been spotted under Bridge 15 and the watercourses are connected. A wood turtle survey should be conducted.

Also listed within the review area is the federally endangered northern long-eared bat, however it was determined that this location may effect, not likely to adversely effect the northern long-eared bat, and no critical habitat was located near the bridge location.

Agricultural

The review area noted prime statewide and prime agricultural soils were mapped in the vicinity and around the project location.

ii. Historic

One Historic resource was identified within the immediate project area. The historic resource is considered a Section 4(f) property and is as follows:

- Bridge No. 11 (Lower Cox Covered Bridge) which is individually listed in the National Register of Historic Places (NRHP) and it remains significant under Criterion C.

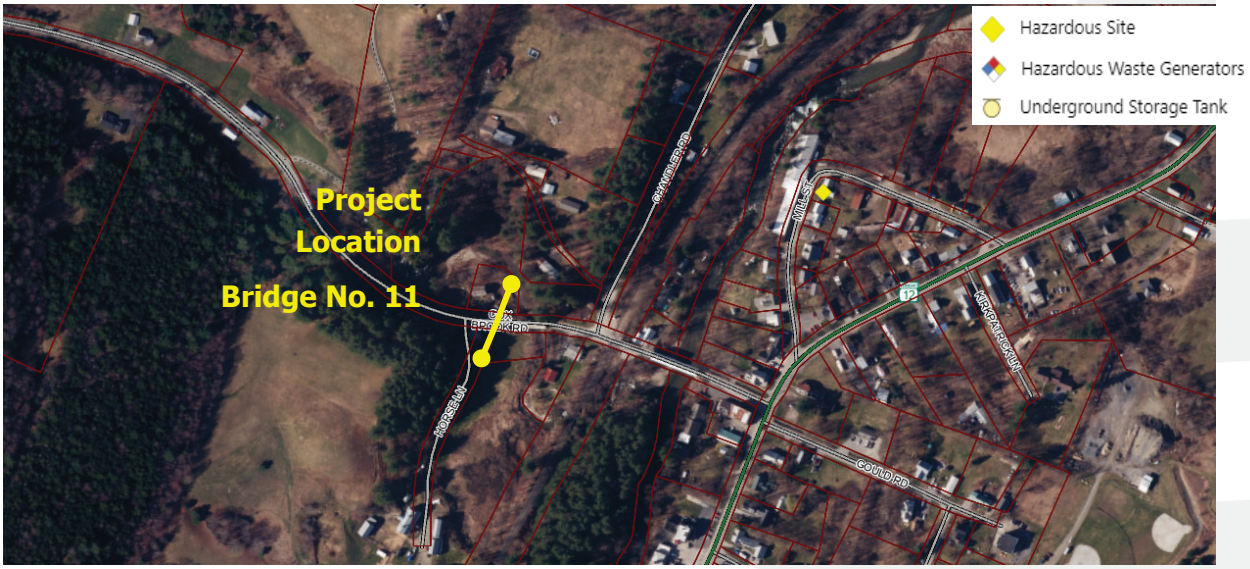
The Lower Cox Covered Bridge was listed on the National Register of Historic Places on July 15, 1974 (National Register of Historic Place Inventory Nomination Form). The project was initially presented at the Historic Covered Bridge Preservation Committee (HCBPC) meeting on September 4th and 12th, 2024. The committee reviewed the proposed project based on the Historic Covered Bridge Preservation Plan and Section 106 review process set forth by the National Historic Preservation Act of 1966, as amended, and the Advisory Council on Historic Preservation's Procedures for the Protection of Historic Properties (36 CFR 800c) and recommended replacing the existing steel beams with glulam beams. They did not recommend an alternative based on live loading.

iii. Archaeological

The VTrans archaeological unit will investigate the project limits during the next phase of project development to determine any archaeologically sensitive areas.

iv. Hazardous Materials

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there are no hazardous waste sites or hazardous waste generators related in the vicinity of the project location. See the figure below for a map of Hazardous Sites. The project area also does not show in the VT Hazardous Waste Urban Soils Map.



v. Stormwater

There are no stormwater concerns at this site. The project area is relatively flat with no roadway curbing and stormwater runoff involves overland flow into Cox Brook.

2. SAFETY

There have been no reported crashes along Cox Brook Road in Northfield within the last 5-year period.

There are no High Crash Location segments located within the project area.

3. COMMUNITY NEEDS AND CONSIDERATIONS

A community questionnaire was sent to the Town to fill out. The town noted seasonal visitors to the bridges in the summer months, including bus tours, but the slow season is considered winter and spring. For a long-term closure, emergency services and school buses would take a 4-mile Class 4 town road detour. Cox Brook Road connects Northfield to Berlin and Moretown, so users would need to take the same detour as emergency services, which is a gravel road and not designed for significant traffic. The town noted significant numbers of bicycle and pedestrian users on the bridge, which should be accommodated during construction. There were no known instances of flood waters impacting the bridge.

The Local and Regional Input Questionnaire can be found in Appendix J.

Public involvement for this project included a Local Concerns Meeting and Alternatives Presentation Meeting held in-person and as summarized below.

a. Local Concerns Meeting

A Local Concerns Meeting was held on March 26, 2024, at the Brown Public Library. Attendees included the Northfield Selectboard, VTrans and Hoyle Tanner personnel, and members of the public. The Local Concerns Meeting was regarding three different covered bridges that were inspected by Hoyle Tanner. Many of the discussion topics were applicable to all three bridges. The following were discussed:

- *Oversized Vehicles:* The bridge has substandard vertical clearance. Despite warning signs, oversized vehicles have repeatedly crossed the bridge, hitting and damaging the upper lateral bracing and cross beams. Many residents expressed concern about this and asked about mitigation measures that could be taken to deter oversized vehicles from using the bridge, including an over-height bar, cameras, alerts in map apps, and increasing the vertical clearance in the bridge. Over-height bars can be a safety concern if they are rigid, but a swinging bar could be an option. There are many mapping apps and it is difficult to get alerts in all apps that the traveling public use.
- *Enforcement:* The Town is responsible for enforcing load restrictions on any Town structure currently posted.
- *Guardrail and Signage:* It was noted that the approach guardrail is in poor condition, and the approach signing is covered by foliage. The Town is responsible for maintaining approach guardrail and clearing vegetation.
- *Bridge Closure During Construction:* There was a question about how long the bridge would be closed during construction. The bridge would be closed for an entire construction season. The shortest route around is Cox Brook Road, to VT Route 12, Water Street, Union Street, Union Brook Road, and Aseltine Road, and back to Cox Brook Road which has an end-to-end distance of 6.1 miles. Several concerns were bought up at the meeting about the detour route. Participants

expressed concern that Aseltine Road is not well maintained. It was noted that in the past, Pearson Hill was connected to Dunham Drive as a temporary detour. These will be investigated during the scoping process. Because this is a Town owned structure, the Town would ultimately be responsible for choosing and signing the detour route according to the Manual on Uniform Traffic Control Devices (MUTCD). VTrans often encourages Towns to reach out to our district offices for questions regarding what signs are required and where they should be placed. The Town would also be responsible to obtain permits from VTrans Operations Bureau for any signs that would be placed within the State Right-of-Way. The requirements for the detour will be detailed in the Finance and Maintenance Agreement.

- *Temporary Bridge:* A resident expressed interest in a temporary bridge option. A temporary bridge could be installed for access during construction, but the site conditions would make turning movements difficult to meet design standards.

b. Alternatives Presentation Meeting

An Alternatives Presentation Meeting was held on March X, 2026 at the Brown Public Library. Attendees included the Northfield Selectboard, VTrans and Hoyle Tanner personnel and members of the public. The following were discussed:

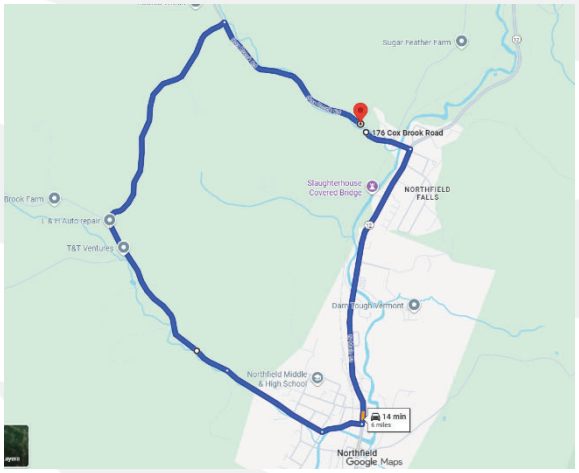
- Discussion Topics

4. MAINTENANCE OF TRAFFIC

In accordance with Vermont Agency of Transportation guidance this project was reviewed to determine suitability for the Accelerated Bridge Program which focuses on faster delivery of construction plans, permitting, and Right-of-Way, as well as faster construction of projects in the field. One practice that will help in this endeavor is closing bridges for portions of the construction period, rather than maintaining traffic on a portion of the existing bridge during construction or providing temporary bridges. In addition to saving money, the intention is to minimize the closure period with faster construction techniques and incentives to allow contractors to complete projects sooner. The Agency will consider the closure option on most projects where rapid reconstruction or rehabilitation is feasible.

a. Off-site Detour

This option would close the bridge and reroute traffic onto an offsite detour. Since the bridge is located on a Class 2 Town Highway, it would be the responsibility of the Town of Northfield to choose the preferred detour route and to sign it according to the MUTCD manual. If the preferred detour route goes through an adjacent Town, it will be the responsibility of the Town of Northfield to coordinate with that Town.



The most likely detour route has an end-to-end distance of 6.1 miles and adds 4.8 miles to the through route. This route is as follows:

- Cox Brook Road, to VT Route 12, Water Street, Union Street, Union Brook Road, and Aseltine Road, and back to Cox Brook Road (6.1 mi end-to-end)

Advantages: This option eliminates the need for a temporary bridge to maintain traffic during construction, significantly reducing both construction time and cost. It also minimizes impacts to adjacent properties and environmental resources. Overall, this approach lowers project expenses and duration during both design and construction phases. Additionally, it provides the safest traffic control method by removing the traveling public from the active construction area.

Disadvantages: Traffic flow would not be maintained through the project site during construction. Additionally, the detour route contains portions of Class 4 Town Highways which typically are narrow, steep, and not well maintained.

Due to the above-mentioned disadvantages of an off-site detour, it is not recommended that this option for maintenance of traffic be utilized for this project.

b. Temporary Bridge

From a constructability standpoint, a temporary bridge could be placed on the downstream side of Lower Cox Covered Bridge. A temporary bridge on the north side would have fewer impacts to aerial utilities but would still require some relocation. The downstream temporary bridge would require tree clearing.

If a temporary bridge is utilized, borings should be drilled at the temporary abutment locations.

Based on the daily traffic volumes and length of the bridge, a one lane alternating temporary bridge would be recommended.

Advantages: A temporary bridge will maintain traffic flow through the project corridor during construction. A temporary bridge is considered safer during construction than phased construction.

Disadvantages: This traffic control option would be costly and time-consuming, as additional time is needed to construct the temporary bridge and approaches.

Due to the above-mentioned advantages of a temporary bridge, and the disadvantages associated with an off-site detour, it is recommended that this option for maintenance of traffic be utilized for this project. The Cost Matrix, shown in Section 6 below, includes the temporary bridge cost in the Bridge category subtotal and overall project costs. By using a temporary bridge instead of an off-site detour, the Town's share of the construction costs is 5%.

c. Phased Construction

Another method of maintaining traffic along a corridor during construction is to build a new structure one lane at a time, or in phases.

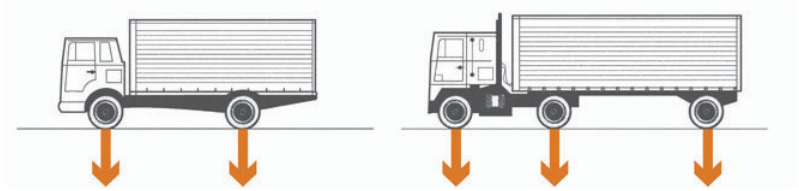
Advantages: This would maintain traffic along the existing corridor during construction.

Disadvantages: Typically, the time required to construct a phased construction project is longer than a project constructed without phasing, because some of the construction tasks must be performed multiple times and cannot be performed concurrently. The costs of construction also increase over unphased work because of this increase in the length of time, the additional inconvenience of working around traffic, and the effort involved in coordinating the joints between the phases.

The existing bridge is a one-lane structure with a 15'-5" minimum width face of truss to face of truss typical. This does not provide enough width to phase construction and the type of construction required for covered bridges does not allow phasing of work. As such, phased construction will not be considered further.

5. ALTERNATIVES DISCUSSION

a. Structural Analysis



H Truck on the left, HS Truck on the Right

A structural analysis and load rating was performed of all primary live load carrying members of the bridge superstructure. Superstructure roof framing members were also checked for the applied wind, snow, and dead loads. The Service Load (Allowable Stress) Rating method was used for all members in accordance with the provisions of the American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges, 17th Edition, AASHTO Manual for Bridge Evaluation Third Edition with 2019 Interim Revisions (MBE), and the 2010 VTrans Structures Design Manual. The bridge was rated to determine the allowable rating vehicle in terms of H Truck, which is a truck with two axles spaced at 14 feet with 20% of the load on the front axle and 80% on the rear axle. Per the scope of services, the bridge was rated for four AASHTO live loads; H20 (20 tons), HS20 (36 tons), H15 (15 tons), HS15 (27 tons). All structural members were rated for single lane loading configurations. The controlling live load force effect for each AASHTO live load was taken as the maximum of the design truck or the lane load. Excel spreadsheets, MathCAD computer program, STAAD, and hand calculations were utilized to calculate the as-inspected section properties, capacities, and load rating values.

Since the timber stringers were previously replaced with steel beams, the timber trusses of the bridge only carry their own self-weight, wind loads, and snow loads. The steel beams support their own self-weight and the vehicular live loads. To differentiate these two different types of loadings in the ratings below, live-load carrying members are reported in terms of Load Factors, while non-live-load carrying members are reported in terms Performance Factors.

For the floor system (steel beams and decking) the inventory rating was determined by combining the maximum design load effects of the dead and live load compared to the allowable inventory stress levels, while the operating rating was determined by combining the maximum effects of the live load, dead load, and snow load (as applicable) as compared to the higher operating stress levels.

Allowable stress values for wood members were obtained from the 2018 National Design Specification for Wood Construction and Supplement (NDS). The wood species used in the superstructure was identified through testing. The grade assigned to each member was based on a visual examination of knots, checks, slope of grain of the wood, and growth rate characteristics of the wood. All superstructure members are wood unless noted otherwise. The substructure was not analyzed as part of the load rating since it was not expected to control the load rating of the bridge.

The steel beams were analyzed using the Load Factor Method (LFR) per the MBE. The inventory rating was determined by combining the maximum effects of the dead and live load effects compared to the allowable inventory stress levels, while the operating rating was determined by combining the maximum effects of the dead and live load (as applicable) as compared to the higher operating stress levels.

Our initial recommendations for repair or replacement of each member are detailed in the following sections. These were reviewed by the Historic Covered Bridge Preservation Committee (HCBPC) so the structural and historical issues could be weighed to determine a rehabilitation live load that met the project goals, while preserving as much of the original fabric of the covered bridge as possible. We have

also identified the priority treatment number (PTN) from the Historic Covered Bridge Preservation Plan to aid in review of the recommendations.

It should be noted that not all members to be replaced can be identified based on our inspection due to inaccessible areas (i.e. top-face rafters, etc.). The estimate of cost in this study includes an additional amount of conditional replacement based on Hoyle Tanner's experience with similar structures to determine an appropriate budget for the project.

Roof Framing

Analysis

The roof rafters and roof boards were analyzed for dead load, wind load (9.0 pounds per square foot (psf) upward on the windward roof and 14.3 psf uplift on the leeward roof) and a ground snow load of 60.0 psf (30.9 psf roof applied) per the 2015 Vermont Fire and Building Safety Code snow load and the 2022 ASCE 7 Minimum Design Loads for Buildings and Other Structures. Our structural analyses showed that roof boards and rafters are adequate for the applied dead, wind, and snow loads (16% utilized for the roof boards and 52% utilized for the roof rafters).

Recommendations

The existing metal roof is in poor condition. It is attached to underlying members with nails, which allow water to seep into the bridge over time. During rehabilitation, the existing metal roof would most likely be damaged by the removal of certain truss and roof members and will need to be replaced. We recommend that the entire metal roof, all of the roof boards, 5 roof rafters (5%), 1 rafter support beam (8%) be replaced in-kind (Priority Treatment No.2) (PTN 2) due to condition. Roof boards are 1" thick Eastern Spruce, rafters are 2"x6" Eastern Spruce, and rafter support beams are 6"x6" Eastern Spruce. These roof framing recommendations apply to Alternatives 1 through 4.

Upper Lateral Bracing

Analysis

The existing upper lateral bracing, which consists of two diagonal braces, cross beams, and timber knee braces attached to truss verticals using nails, was analyzed for wind loading in conformance with ASCE 7-22. A grade of No. 1 was assigned to all upper lateral bracing wood members based on a visual examination of the wood. A portion of the lateral wind load based on the tributary area is applied to the existing upper later cross beams. Our analysis showed the diagonal bracing system is adequate to keep the bridge square and plumb and to resist code required wind loads.

Recommendations

The following recommendations are expected to improve and strengthen the upper lateral bracing:

- Replace both diagonal braces in-kind (PTN 2)
- Replace 2 crossbeams (29%) in-kind (PTN 2)
- Replace 7 knee braces (29%) in-kind (PTN 2)
- Strengthen all knee braces connections using lag bolts (PTN 3)

These upper lateral bracing recommendations apply to Alternatives 1 through 4.

Trusses

Analysis

The Queenpost Truss members were assigned a grade of select structural based on a visual examination of the wood.

The trusses were analyzed to determine their current and proposed dead load capacity. A 2-Dimensional bridge computer model of the Queenpost Trusses was utilized for the structural analysis.

To determine the current capacity of all truss members, full dead and snow loads were applied and compared to allowable stress levels. See Table 1 below for a summary of all members rated.

Table 1 – Queenpost Truss Members Rating Summary

Member	**No. of Members – Size**	**Performance Factor[1]**
Top Chord	1 – 8”x10”	2.00
Bottom Chord	2 – 6”x12”	1.90
Queen Posts (Vertical 2)	2 – 8”x10”	5.00
Diagonals	2 –8”x10”	3.56
Verticals	5 – 6”x6”	1.32

1. Performance factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design loads.

To determine the current capacity of all truss member connection details, full dead and snow loads were applied and compared to allowable stress levels. See Table 2 below for a summary of all member connection ratings.

Table 2 – Member Connections Rating Summary

Connection #	**Location**	**Performance Factor[2]**
Connection #1	Vertical, Top Chord, and Diagonal	2.99
Connection #2	Diagonal and Bottom Chord	1.27
Connection #3	Vertical and Bottom Chord	3.50
Connection #4	Bottom Chord Splice, North Truss	1.90
Connection #5	Bottom Chord Splice, South Truss	0.15

2. Performance factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design loads.

<u>Recommendations</u>

Since the truss members are not carrying any live load and all rate over 1.0, the removal and replacement of the truss members is due to condition and the same for all alternatives (PTN 2). See Appendix E for members that are required to be replaced. Epoxy injection into the large splits of a few members and rotted areas is also recommended to lessen further splitting and deterioration to these members (PTN 1).

One connection did not rate above a 1.0 and will require strengthening to meet sufficient capacity to safely carry design loads.

Recommendations for member replacements is detailed below. All replacement wood is to be Douglas Fir Select Structural grade unless noted otherwise.

North Truss member replacements and repairs:

- Epoxy repair deteriorated members (PTN 1)

South Truss member replacements and repairs:

- Replace bottom chord in-kind between nodes 1 & 4 (PTN 2)
- Strengthen bottom splice connection (PTN 3)
- Epoxy repair deteriorated members (PTN 1)

Floor System

Analysis

The existing decking and stringers were analyzed to determine the live load capacity. The load rating summary for the deck is shown in Table 3. The tire contact area used for the deck load rating varies based on the applied load. As such, the deck rating for each design truck varies and the Rating Factor for each design truck is reported below. The load rating summary (in "H tons") for the stringers is shown in Table 3. The rear axle of the design truck controlled the load rating of all floor system members. The deck has been assigned a grade of No. 1 for the structural analysis based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

Table 3 - Existing Deck Load Rating Summary

Live Load Alternative	**Inventory Rating Factor[3]**	**Operating Rating Factor[3]**
Alternative 1 – H15	1.5	2.0
Alternative 2 – HS15	1.5	2.0
Alternative 3 – H20	1.1	1.5
Alternative 4 – HS20	1.1	1.5

3. Rating factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design live load.

Table 4 – Existing Interior (24WF84) Stringer Load Rating Summary

Live Load Alternative	**Inventory Rating Factor[4]**	**Operating Rating Factor[4]**
Alternative 1 – H15	0.61	1.01
Alternative 2 – HS15	0.34	0.56
Alternative 3 – H20	0.46	0.76
Alternative 4 – HS20	0.25	0.42

4. Rating factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design live load.

Table 5 - Existing Exterior (24WF84) Stringer Load Rating Summary

Live Load Alternative	Inventory Rating Factor[5]	Operating Rating Factor[5]
Alternative 1 – H15	0.51	0.85
Alternative 2 – HS15	0.28	0.47
Alternative 3 – H20	0.38	0.64
Alternative 4 – HS20	0.21	0.35

5. Rating factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design live load.

Recommendations

It is recommended that all stringers be replaced due to strength, age, and condition for Alternatives 1, 2, 3, and 4 (H15, HS15, H20, and HS20, respectively). The existing stringers have deteriorated beyond meaningful cleaning and repair work, and given their age, are due for replacement. It is recommended that the steel stringers be replaced with glulam beams (PTN 2). See Sections 5.d through 5.g of this report for additional details on each rehabilitation alternative.

The existing nail laminated deck is adequate for all alternatives; however, the deck will need to be removed to facilitate stringer replacement. This work will likely damage the deck as removal of a nail laminated deck is difficult, requiring a replacement nail laminated deck (PTN 2) or glue laminated deck (PTN 4) to be installed. For all alternatives, it is recommended that the existing runner boards be replaced with 1½" thick full-width runner boards (PTN 2). This helps to provide a smoother and wider traffic surface and could help prevent vehicles from losing control if a tire runs off the runner boards.

In addition, it is recommended that a new wood curb be added to the bridge to help keep vehicles from impacting the trusses. This curb has previously been used by VTrans on the Hutchins, Comstock, and Longley Covered Bridges in Montgomery and many other covered bridges rehabilitations throughout the State.

b. Substructure

The existing abutments have not been analyzed for overturning and sliding per the VTrans structures manual since they appear stable with no signs of distress and there is exposed bedrock at the bridge location.

Overall, the west abutment appears sound and globally stable with no apparent sign of movement, settlement, or tipping. Some isolated voids, cracks, and spalls were found on various surfaces of the existing substructure elements. The east abutment has large voids, cracks, and spalls, with undermining at the footing. The scope of work does not include the stability analysis of the existing substructure.

Recommendations

The following recommendations are made for the east abutment bridge substructure:

- Replace the east abutment with a reinforced concrete abutment (PTN 2).
- Replace truss bearing blocks (PTN 2).
- Remove all vegetation and small trees (PTN 1).

The following recommendations are made for the west abutment bridge substructure:

- Replace the backwall (PTN 2).
- Modify west abutment bridge seat elevation to accommodate replacement stringers (PTN 1).
- Conduct minor partial depth concrete repairs to all existing west substructure elements (PTN 1).
- Grout and seal the concrete cracks greater than ⅛" in width (PTN 1).
- Stain and seal all exposed concrete surfaces with a water-based sealant in order to provide long-term protection of the concrete (PTN 1).
- Replace truss bearing blocks (PTN 2).
- Remove all vegetation and small trees (PTN 1).

c. No Action

This alternative would leave the bridge as it currently exists. A general guideline for evaluating a "No Action" alternative is determining whether the structure can remain in service for at least the next 10 years without requiring any work. The existing bridge superstructure is in poor condition, with multiple components—including truss members, bearing blocks, and upper lateral bracing—with numerous deficiencies. For safety reasons, maintaining the bridge in its present state is not recommended. No cost estimate is provided for this alternative, as it does not involve any immediate expenditures.

d. Alternative 1: Rehabilitation for H15 (15-Ton) Loading

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 15-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Replacement of all steel stringers with 10½"x27½" Southern Yellow Pine glulam beams (PTN 4).

e. Alternative 2: Rehabilitation for HS15 (27-Ton) Loading

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 27-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Replacement of all steel stringers with 10½"x33" Southern Yellow Pine glulam beams (PTN 4).

f. Alternative 3: Rehabilitation for H20 (20-Ton) Loading

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 20-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Replacement of all steel stringers with 10½"x30¼" Southern Yellow Pine glulam beams (PTN 4).

g. Alternative 4: Rehabilitation for HS20 (36-Ton) Loading

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 36-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Replacement of all steel stringers with 10½"x35¾" Southern Yellow Pine glulam beams (PTN 4).

h. Proposed Roadway Improvements

Along the southern approach, the roadway will mimic existing conditions and transition approximately 50' before the bridge to a 14'-3" paved roadway at the bridge. The proposed roadway typical paved section south of the bridge will consist of removal of existing pavement and enough subbase material to provide suitable draining roadway fill beneath the pavement. Final pavement design will be provided by VTrans.

The approach roadway width will mimic the existing conditions measuring 14'-3" at the bridge and gradually widening to match the existing width at the end of the project limits. The proposed roadway typical section between the bridge and project limits will match the proposed paved typical section.

Stormwater flow patterns will mimic existing conditions with sheet flow of the roadway to vegetated side slopes. Stop drains or lowering the grade at one end of the bridge will be considered in final design to improve drainage conditions. New steel backed timber guardrail is proposed on both approaches and will closely match existing guardrail lengths.

It is recommended that tree removal and trimming take place on both sides of the bridge as many of the nearby tree branches have potential to grow over the bridge and could fall and damage the bridge and are also promoting insect infestation of the bridge.

i. Fire Protection

As part of this Scoping Report, the bridge was assessed for improvements against the potential for loss or damage from fire. There are no known fire detection or protection systems at the covered bridge site. Three fire detection/protection systems are generally used for covered bridges, each of which was evaluated for this project.

Intumescent or Fire-Retardant Coatings (Nochar/Polaseal)

These coatings are water-based, water repellent treatments that are specifically designed to protect exterior and interior wood surfaces. They penetrate the wood and then cure by reaction with air to lock into the pore structure of the wood. These coatings work by raising the flashpoint of the wood making it difficult to start a fire. The fire-retardant coatings contain a proven fire retardant *to reduce* flame spread in the event of a fire and a blend of special preservatives to fight against the causes of decay. The coatings are available in colored and clear versions that are applied to the wood by brush or spray. The coatings do not affect the strength of the wood. It is also recommended the application of a fungicide to the bridge members to defend against fungal growth. Infestation by fungi causes the wood to rot, lowering the capacity of affected members.

The application of fire-retardant coatings is recommended for all alternatives considered.

Fire Detection System (Protectowire)

If a fire is started, it is advantageous to notify the local fire department as soon as possible. The "Protectowire" is a proprietary alert system that works by running a small wire through key locations in the bridge. The sensor cable is comprised of steel conductors individually insulated with a heat sensitive polymer. The insulated conductors are twisted together to impose a spring pressure between them and wrapped with a protective tape. If a rapid rise in temperature is detected or if a wire is cut, the system alerts the local mutual aid or fire department. This advanced warning can greatly reduce fire damage to a bridge and hopefully prevent the fire from making the bridge a total loss.

It should be noted that there is an annual maintenance cost associated with this system. The system requires power and a phone line (land or cell) to contact mutual aid. In addition, the control box contains batteries that have small electric strip heaters on them to prevent damage from freezing during cold weather. The control box is typically hidden at the end of the bridge in the siding and can be well insulated to reduce electrical costs.

The fire detection system will be discussed with the Town at the alternatives presentation meeting.

Dry Deluge Sprinkler System

The purpose of a deluge sprinkler system is to prevent the spread of fire by wetting down the entire fire area. The sprinkler system typically used includes dry pipes with a fire department connection away from the ends of the bridge. During a fire, the fire department feeds the system which directs water to the source of the fire. The majority of the piping and heads are in the roof; however, coverage is also provided under the bridge at the abutments. These systems are typically used in long or multi-span bridges where the fire department cannot effectively fight the fire near the center of the bridge.

The sprinkler system will be discussed with the Town at the alternatives presentation meeting.

j. Lighting

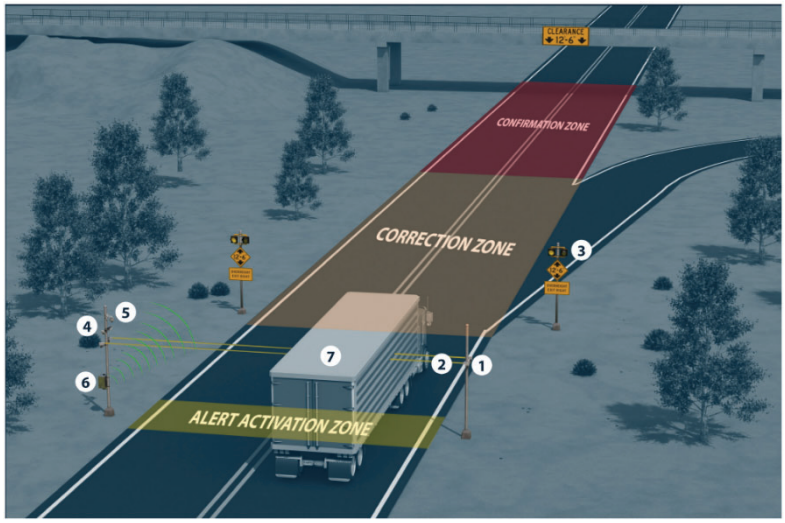
There is currently no lighting on the bridge or immediate approaches to it. Lighting can be an effective means to deter vandalism and improve visibility. The decision to add lighting to the bridge should be made by the Town. Interior lighting in the form of high-pressure sodium lights controlled by photocells may be added if desired. This type of lighting provides a light brown color and is the type preferred by state historic resource agencies. The fixtures proposed in this study have a good long-term performance record, are unobtrusive as they are installed in between the upper lateral bracing, and are reasonably vandal proof. The photocell is specified to help ensure that the lights are only on when needed.

The lighting system will be discussed with the Town at the alternatives presentation meeting.

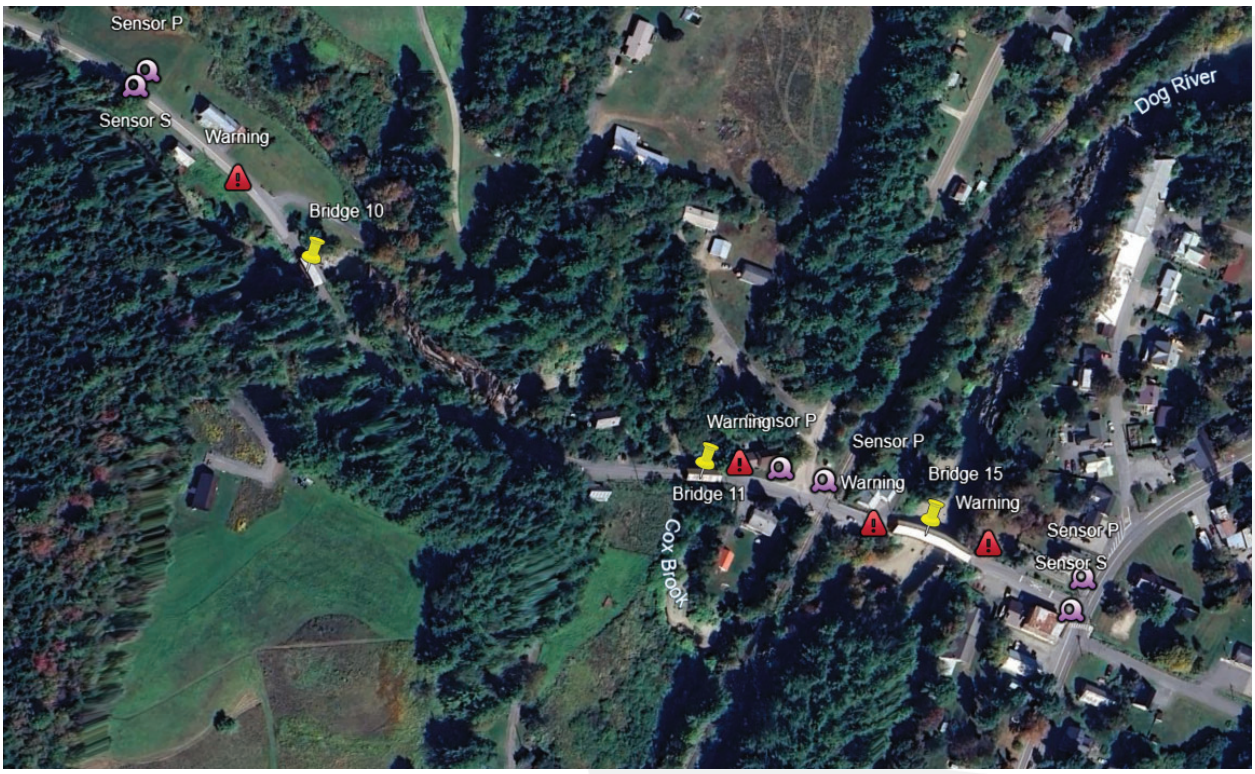
k. Vertical Clearance

The existing vertical clearance on the bridge is approximately 12'-10", which is substandard and causing impact damage to the portals, cross braces, upper lateral bracing, and knee braces due to oversized vehicles. The same is true of the other two covered bridges on Cox Brook Road. It is proposed to increase the vertical clearance of all three bridges to a uniform 13'-0". At the Lower Cox Covered Bridge, this would be done by replacing the existing steel lateral bracing with a new bottom chord assembly and blocking that would raise the truss members enough to achieve the desired vertical clearance. The siding will extend down enough to cover this assembly unit, so it is not visible on the exterior. Curbing and deck widening on the inside would cover the assembly unit from view on the inside of the truss.

This option was presented to the HCBPC and was approved as an acceptable modification to the existing structure.



Additionally, early detection and vehicle warning systems can be incorporated into the project. These systems use sensors within an "activation zone" to identify vehicles that exceed the clearance height of an upcoming structure and alert drivers to the restriction. Drivers are then guided toward a safe alternate route within the "correction zone". The system also collects data, such as license plate information, for vehicles that trigger the warning and notifies local authorities when a vehicle enters the "confirmation zone". A potential layout of this system for the three covered bridges along Cox Brook Road is shown below. The associated cost, estimated at approximately $125,000, is not included in the Cost Matrix in Section 6, as the system is proposed as an optional enhancement.



1. Construction Schedule

Lower Cox Covered Bridge is one of three bridges on Cox Brook Road scheduled for rehabilitation. The rehabilitation of this bridge is expected to take approximately one construction season (about eight months). Upper Cox Covered Bridge, located 0.1 miles to the north, is also anticipated to require one construction season, while Northfield Falls Covered Bridge, located 0.2 miles to the south, will likely require two construction seasons.

Because these projects are in close proximity, there may be opportunities for cost and schedule savings by bundling two or all three bridges into a single contract. Temporary bridge alternatives for Bridges 10 and 11 share the same span length and width requirements, allowing the same temporary structure to be reused at both sites. Bridge 15 has a short local detour available for traffic maintenance.

Covered bridge rehabilitation is a highly specialized type of construction, and contractors often have limited crews with the required expertise. For this reason, the Town may consider bundling Bridges 10 and 11 into a single contract. Under this approach, one contractor could complete both projects over two construction seasons, using the same specialized crew and the same temporary bridge at each site. Bridge 15 could then be bid separately and constructed over the same two seasons, allowing all three bridges to be completed within a two-year period.

Alternatively, all three bridges could be bid together as one project and completed over four years, or they could be bid individually, giving contractors the flexibility to pursue one, two, or all three projects.

6. COST MATRIX

Northfield BO CVBR(8)		Do Nothing	Alternative 1 Rehabilitation for H15 (15-Ton, 2 Axle) Loading	Alternative 2 Rehabilitation for HS15 (27-Ton, 3 Axle) Loading	Alternative 3 Rehabilitation for H20 (20-Ton, 2 Axle) Loading	Alternative 4 Rehabilitation for HS20 (36-Ton, 3 Axle) Loading
COST[1]	Roadway	$0	$522,392.50	$522,392.50	$522,392.50	$532,392.50
	Erosion Control	$0	$50,000.00	$50,000.00	$50,000.00	$50,000.00
	Bridge[2]	$0	$1,606,905.00	$1,621,905.00	$1,614,405.00	$1,630,905.00
	Full CE Items	$0	$40,000.00	$40,000.00	$40,000.00	$40,000.00
	Construction Costs	$0	$2,220,000.00	$2,235,000.00	$2,228,000.00	$2,254,000.00
	Construction Engineering & Contingencies (CEC)	$0	$555,000.00	$559,000.00	$557,000.00	$564,000.00
	Accelerated Premium	$0	$0	$0	$0	$0
	Total Construction Costs with CEC	$0	$2,775,000.00	$2,794,000.00	$2,785,000.00	$2,818,000.00
	Preliminary Engineering	$0	$555,000.00	$559,000.00	$557,000.00	$564,000.00
	Right of Way	$0	$25,000.00	$25,000.00	$25,000.00	$25,000.00
	Total Project Costs	$0	$3,355,000.00	$3,378,000.00	$3,367,000.00	$3,407,000.00
	Annualized Costs	$0	$83,875.00	$84,450.00	$84,175.00	$85,175.00
	TOWN SHARE[3]	$0	$167,750.00	$168,900.00	$168,350.00	$170,350.00
	TOWN %[3]	0%	5.0%	5.0%	5.0%	5.0%
SCHEDULING	Project Development Duration	N/A	3 years	3 years	3 years	3 years
	Construction Duration	N/A	8 to 12 months	8 to 12 months	8 to 12 months	8 to 12 months
	Closure Duration (If Applicable)	N/A	8 months	8 months	8 months	8 months
ENGINEERING	Typical Section - Roadway (feet)	23’	23’	23’	23’	23’
	Typical Section - Bridge (feet)	15’-5”	11'	11'	11'	11’
	Geometric Design Criteria	Substandard Width	Substandard Width	Substandard Width	Substandard Width	Substandard Width
	Traffic Safety	No Change	Improved	Improved	Improved	Improved
	Alignment Change	No Change	No Change	No Change	No Change	No Change
	Bicycle Access	Substandard	Substandard	Substandard	Substandard	Substandard
	Pedestrian Access	Substandard	Substandard	Substandard	Substandard	Substandard
	Hydraulics	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard
	Utilities	No Change	No Change	No Change	No Change	No Change
OTHER	ROW Acquisition	No	Yes	Yes	Yes	Yes
	Road Closure	No	No	No	No	No
	Design Life (years)[4]	<10	40	40	40	40

[1] Costs are estimates only, used for comparison purposes.

[2] Bridge subtotal includes the cost of a temporary bridge.

[3] The Town Share and Town % of projects using a temporary bridge is 5%. Town Share and Town % decreases to 2.5% if an off-site detour is used.

[4] A design life of 40 years will be assumed for the deck and superstructure rehabilitation options. Substructure rehabilitation is assumed to have a design life of 50 years.

7. CONCLUSION

The Lower Cox Covered Bridge (Bridge No. 11), built in 1872, is a Town-owned bridge located on Town Highway 3 (Cox Brook Road) just west of the intersection with Chandler Road. It is a 55'-3" long single span queenpost truss which carries one lane alternating traffic over the Cox Brook near Northfield Falls, an unincorporated village in the Town of Northfield. The bridge has undergone numerous changes and additions throughout its history with various degrees of documentation.

A detailed inspection and load rating of the bridge was completed to determine if the bridge can meet the project purpose and need. The roof framing was determined to be adequate for code required dead, wind, and snow loads. The bridge lateral bracing system was determined to be adequate for code required wind loads, however modifications to the bracing system are recommended to prevent bowing and racking of the truss. The truss members were determined to be adequate for code required dead, wind, and snow loads, however modifications are recommended to repair some select members due to their deteriorated condition and to increase the capacity of one of the connections of the bottom chord members. The floor system was determined to not be adequate for H15 (15-ton) loading at inventory or operating level. The west abutment appears to be adequate with minor repairs and modifications recommended to accommodate the new floor system, while the east abutment is in poor condition and recommended for complete replacement with reinforced concrete.

Based upon our inspection and analysis of the Lower Cox Covered Bridge it appears feasible to rehabilitate the bridge for vehicular loading to meet the project's purpose and need. Several alternatives were considered and studied as described above in Section 5.

The Town Selectboard and public at the March DATE, 2026 meeting approved Alternative X – Rehabilitation for HXX (XX-ton) loading. Alternative X promotes a safe transportation system, increases the load carrying capacity of the crossing for the emergency responses vehicles, promotes economic development and growth of the Town of Northfield, and maintains the historic character of the covered bridge.

The total estimated construction cost of all recommended work items for Alternative X, in 2026 dollars, is $X,XXX,XXX.

This Scoping Report has been completed utilizing information available as of March 2026. This information may include the Design Criteria listed above, permitting requirements, field data obtained by Hoyle Tanner, and reports or survey information prepared by others, which are subject to change. The condition of an existing bridge can change rapidly, or the bridge be damaged through manmade or natural events that could alter the conclusions reached herein. Therefore, the conceptual design, estimate of probable construction costs, and conclusions reached in this Scoping Report should not be relied upon for an extended period.

150 Dow Street • Manchester, NH 03101 • 603-669-5555 • hoyletanner.com

APPENDIX A

VTrans Bridge Inspection Report

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Town: 155 - NORTHFIELD

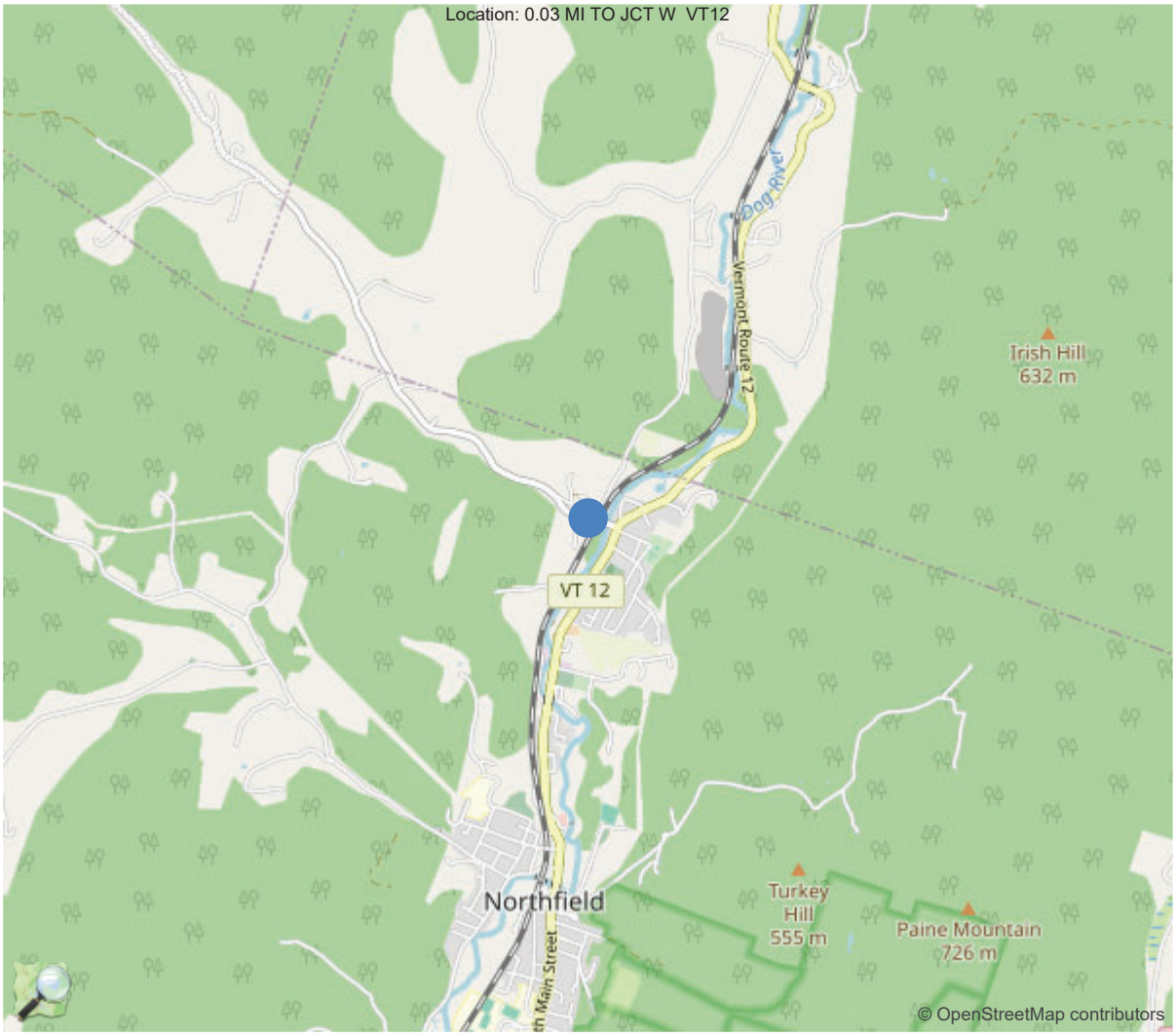
District 6, 23 - WASHINGTON County

Owner: 3 - Town or Township Highway Agency

Maintenance Responsibility: 3 - Town or Township Highway Agency

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024



44.17275, -72.65300

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK

Team Lead: Justin White, **Inspection Date:** 08/20/2024

IDENTIFICATION	
(1) State Names	50 - Vermont
(8) Structure Number	101213001112131
(5) Inventory Route	1
(2) Highway Agency District	6 - District 6
(3) County Code	23 - WASHINGTON
(4) Place Code	50275
(6) Features Intersected	COX BROOK
(7) Facility Carried	C2003
(9) Location	0.03 MI TO JCT W VT12
(11) Mile Point	0 mi
(12) Base Highway Network	No
(13) LRS Inventory Rte & Subrte	
(16) Latitude	44.1727527777778
(17) Longitude	-72.6530027777778
(98) Border Bridge State Code	
(99) Border Bridge Structure No.	
STRUCTURE TYPE AND MATERIAL	
(43) Main Structure Type	32
Material	3 - Steel
Type	2 - Stringer/Multi-beam or girder
(44) Approach Structure Type	00
Material	0 - Other
Type	0 - Other
(45) No. of Spans in Main Unit	1
(46) No. of Approach Spans	0
(107) Deck Structure Type	8 - Wood or Timber
(108) Wearing Surface/Protective System	
Type of Wearing Surface	7 - Wood or Timber
Type of Membrane	0 - None
Type of Deck Protection	7 - Internally Sealed
AGE AND SERVICE	
(27) Year Built	1872
(106) Year Reconstructed	1979
(42) Type of Service	15
On	1 - Highway
Under	5 - Waterway
(28) Lane	
On	1
Under	0
(29) Average Daily Traffic	1200
(30) Year of ADT	2019
(109) Truck ADT	3 %
(19) Bypass, Detour Length	6 mi
GEOMETRIC DATA	
(48) Length of Maximum Span	55 ft
(49) Structure Length	58 ft
(50) Curb or Sidewalk Width	
Left	0 ft
Right	0 ft
(51) Bridge Roadway Width Curb to Curb	14.9 ft
(52) Deck Width Out to Out	15.3 ft
(32) Approach Roadway Width (W/Shoulders)	18 ft
(33) Bridge Median	0 - No median
(34) Skew	0 Deg
(35) Structure Flared	0 - No flare
(10) Inventory Route Min Vert Clear	12.75 ft
(47) Inventory Route Total Horiz Clear	14.9 ft
(53) Min Vert Clear Over Bridge Rdwy	10.5 ft
(54) Min Vert Underclear	0 ft
Ref:	
(55) Min Lat Underclear RT	0 ft
Ref:	
(56) Min Lat Underclear LT	0 ft
NAVIGATION DATA	
(38) Navigation Control	0 - No navigation control on w
(111) Pier Protection	
(39) Navigation Vertical Clearance	0 ft
(116) Vert-Lift Bridge Nav Min Vert Clear	0 ft
(40) Navigation Horizontal Clearance	0 ft

CLASSIFICATION	
(112) NBIS Bridge Length	Y
(104) Highway System	0
(26) Functional Class	8 - Rural Minor Collector
(100) Defense Highway	0 - The inventory route is not
(101) Parallel Structure	N - No parallel structure exis
(102) Direction of Traffic	3 - One lane bridge for 2 - way traffic
(103) Temporary Structure	
(105) Federal Lands Highways	0 - N/A
(110) Designated National Network	0 - The inventory route is not
(20) Toll	3 - On free road. The structu
(21) Maintain	3 - Town or Township Highway A
(22) Owner	3 - Town or Township Highway A
(37) Historical Significance	1 - Bridge is on the National
CONDITION	
(58) Deck	6
(59) Superstructure	5
(60) Substructure	6
(61) Channel & Channel Protection	7
(62) Culverts	N
LOAD RATING AND POSTING	
(31) Design Load	2 - M 13.5 / H 15
(63) Operating Rating Method	2
(64) Operating Rating	
Type	2 - Allowable Stress(AS)
Rating	35
(65) Inventory Rating Method	2 - Allowable Stress(AS)
(66) Inventory Rating	
Type	
Rating	24
(70) Bridge Posting	5 - Equal to or above legal loads
(41) Structure Open/Posted/Closed	P - Posted for load (may inclu
APPRAISAL	
(67) Structural Evaluation	5
(68) Deck Geometry	2
(69) Clearances, Vertical/Horizontal	N
(71) Waterway Adequacy	7
(72) Approach Roadway Alignment	8
(36A) Bridge Railings	0 - Inspected feature does not meet
(36B) Transitions	0 - Inspected feature does not meet
(36C) Approach Guardrail	0 - Inspected feature does not meet
(36D) Approach Guardrail Ends	0 - Inspected feature does not meet
(113) Scour Critical Bridges	8 - Bridge foundations determined t
PROPOSED IMPROVEMENTS	
(75) Type of Work	35 - Bridge rehabilitation bec
(76) Length of Structure Improvement	58 ft
(94) Bridge Improvement Cost (Multiply value by 1000)	$ 311
(95) Roadway Improvement Cost (Multiply value by 1000)	$ 50
(96) Total Project Cost (Multiply value by 1000)	$ 361
(97) Year of Improvement Cost Estimate	2020
(114) Future ADT	1260
(115) Year of Future ADT	2029

INSPECTIONS *			
(90) Inspection Date			08/20/2024
(91) Frequency			24
(92) Critical Feature Inspection	Done	Freq. (Mon)	Date
A: Fracture Critical Detail	No		
B: Underwater Inspection	No		
C: Other Special Inspection			

* The inspection date and frequency information in this box contains the current NBI date and frequency information. Please refer to the report header for the date this inspection was conducted.

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Maintenance Needs

Date Reported: 08/18/2022

Priority:

Status: Open

Type of Work: 25 - Superstructure - Bracing repair

Component: Superstructure

Deficiency Description

The diaphragms have extensive section loss throughout with some perforations in the ends. The upstream diaphragm over abutment 2 has failed.

Remarks

Steel repairs are needed

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Maintenance Needs

Date Reported: 08/20/2024

Priority:	4 - Maintenance Finding - Next Inspection Cycle	**Status:**	Open
Type of Work:	27 - Superstructure - Clean and paint superstructure	**Component:**	Superstructure

Deficiency Description

Rust scale throughout with moderate to heavy section loss. Areas of deep pitting in the surrounding area of the angled bracing support of the covered bridge in the fascia beams. The beam ends remain heavily saturated due to the gravel build up on the bridge seats resulting in heavy section loss. Typical section remaining beam ends (extending out beyond the bridge seat) along the flanges is 3/8”+/- and 1/4”+/- in the lower area of the web.

Remarks

A project to clean and paint the beams should be considered as section loss in the beams continues increase.

Superstructure

Abutment 2 beam ends

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Deck

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
31	Timber Deck	SF	887	0	887	0	0
1140	Decay/Section Loss	SF	887	0	887	0	0
510	Wearing Surfaces	SF	887	887	0	0	0

58 - Deck (6 - SATISFACTORY CONDITION - structural elements show some minor deterioration.)
Mildew staining throughout with moderate to heavy saturation.

200 - Existing Wearing Surface Depth (2")

A21 - Deck Wearing Surface Condition (Good)
Areas of minor abrasion along the wheel paths.

A39 - Deck Fascia Condition (Satisfactory)

B.C.05 Bridge Railing Condition Rating (GOOD - Some minor defects.)

B.C.08 Bridge Joints Condition Rating (NOT APPLICABLE - Bridge does not have deck joints.)

APPROACH

72 - Approach Roadway Alignment (8 - Equal to present desirable criteria)

A13 - Approach Rail Condition (Fair)
Large perforations near and around the anchor points. Other areas are in good condition as they have been replaced with standard W beam.

A16 - Approach Post Condition (Fair)
HD pressure treated posts have wide splits and checks throughout with areas dry rot and some moss growth in the ends.

B.C.06 Bridge Railing Transitions Condition Rating (SATISFACTORY - Widespread minor or isolated moderate defects.)

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
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C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Superstructure

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
107	Steel Open Girder/Beam	LF	220	0	0	220	0
1000	Corrosion	LF	220	0	0	220	0
515	Steel Protective Coating	SF	1210	0	0	0	1210
3440	Effectiveness (Steel Protective Coatings)	LF	1210	0	0	0	1210
311	Movable Bearing	EA	4	0	0	4	0
1000	Corrosion	EA	4	0	0	4	0
313	Fixed Bearing	EA	4	0	0	4	0
1000	Corrosion	EA	4	0	0	4	0

59 - Superstructure (5 - FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spalling or scour.)
Rust scale throughout with moderate to heavy section loss. Areas of deep pitting in the surrounding area of the angled bracing support of the covered bridge in the fascia beams. The beam ends remain heavily saturated due to the gravel build up on the bridge seats resulting in heavy section loss. Typical section remaining in the beam ends (extending out beyond the bridge seat) along the flanges is 3/8”+/- and 1/4”+/- in the lower area of the web.

A50 - Super Verticals/Diagonals Condition (Good)
Minor checks and splits scattered throughout. *The covered portion of the bridge does not aid in supporting the structure.

A51 - Top Chords Condition (Good)
Minor checks and splits scattered throughout. *The covered portion of the bridge does not aid in supporting the structure.

A52 - Bot. Chords Condition (Satisfactory)
The downstream bottom chord has a steel splice plate near the abutment 1 end due to a rotted and split member. *The covered portion of the bridge does not aid in supporting the structure.

A55 - Lateral Bracing Condition (Poor)
Extensive section loss throughout with some perforations in the ends. The upstream diaphragm over abutment 2 has failed.

A65 - Roof/Siding Condition (Good)

B.C.07 Bridge Bearings Condition Rating
Bearings are not visible due to gravel build

B.C.14 NSTM Inspection Condition (NOT APPLICABLE - Component does not exist.)

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Substructure

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
215	Reinforced Concrete Abutment	LF	40	5	20	15	0
1130	Cracking (RC and Other)	LF	30	0	20	10	0
1190	Abrasion/Wear (PSC/RC)	LF	5	0	0	5	0
800	Reinforced Concrete Wing/Retaining Wall	EA	4	0	2	2	0
1130	Cracking (RC and Other)	EA	4	0	2	2	0

60 - Substructure (6 - SATISFACTORY CONDITION - structural elements show some minor deterioration.)
Abutment 1 has map cracking throughout with minor saturation with scattered small areas of rust staining. Abutment 2 has lineal cracking with minor separation along the pour joints, map cracking throughout with light staining and scattered small voided spalls with scaling.

A71 - Abutment End Walls Condition (Satisfactory)
Minor abrasion and voided spalls throughout from tire wear. The added extension of the wall at abutment 1 is not attached and tips towards the backfill and is cracked through at the center.

A77 - Retaining/Wingwall Condition (Satisfactory)
Abutment 1 wall has fine map cracks throughout with light staining. Abutment 2 walls have lineal cracking with minor separation, map cracking with light staining and scattered voided spalling with scaling.

A78 - Abutment Footings Condition (Very Good)

CHANNEL

61 - Channel Condition (7 - Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel have minor amounts of drift.)
Small pocket of scour along upstream end of abutment 1 footing due to channel alignment.

B.C.10 Channel Protection Condition Rating (VERY GOOD - Some inherent defects.)

B.C.11 Scour Condition Rating ((Inactive) (Inactive) TEMP - Scour may exist but has not affected strength or stability - 5 or 6 or 7 or 8 or 9)

GENERAL OBSERVATION

This structure should be considered for a paint project with extensive cleaning of the beams. Steel repairs are needed as well as channel beam diaphragms have extensive section loss and some members have failed. Further section loss in the abutment beam ends will result in more steel repairs or full replacement.

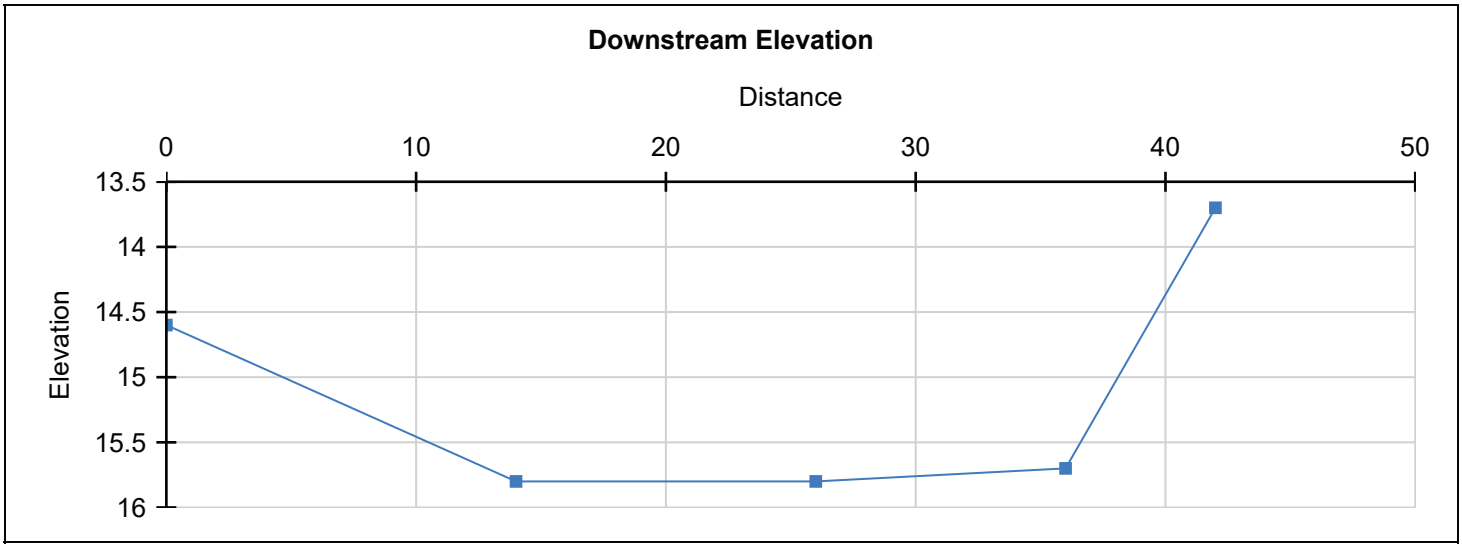
VERMONT
AGENCY OF TRANSPORTATION

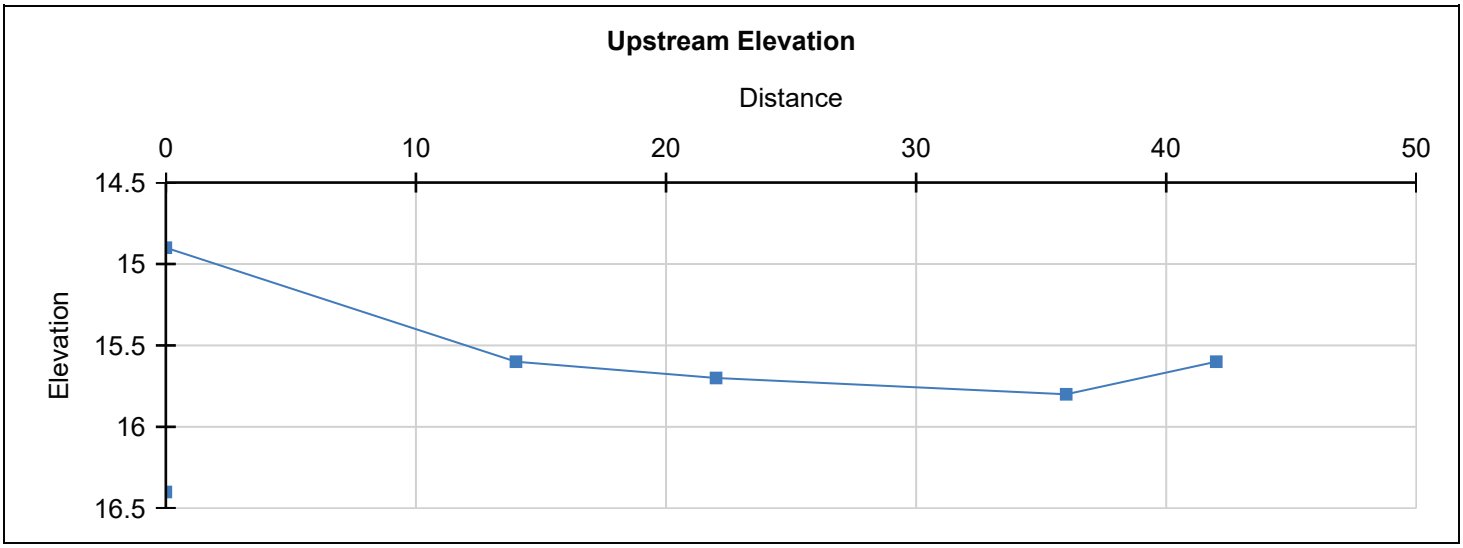
Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Channel Profile

Waterway Flow:	Left to right	Top of Water:	
Origin:	Bottom of fascia	Bottom of Beam:	

Station	Distance	Downstream	Upstream
Abutment 1	0	14.6	16.4
	0		14.9
	14	15.8	15.6
EOW	22		15.7
EOW	26	15.8	
	36	15.7	15.8
Abutment 2	42	13.7	15.6





VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Abutment 1 approach

Abutment 2 approach

Downstream abutment 2 approach

Upstream elevation

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Downstream elevation

Span

Superstructure

Abutment 2 beam ends

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Beam 1 abutment 2 end

Abutment 2

Abutment 1

Abutment 1 backwall

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00011 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Upstream

Downstream

APPENDIX B

Preliminary Hydraulic Report

APPENDIX C

Engineer's Estimate of Probable Construction Costs

HOYLE TANNER
Hoyle, Tanner & Associates, Inc.
125 College Street, 4th Floor
Burlington, VT 05401 (802) 860-1331

Calc. By:	KBL	Date:	5/7/2025
Chck. By:	AG	Date:	6/11/2025
Rev. By:	KBL	Date:	10/7/2025
Chck. By:	JB	Date:	12/31/2025

VTRANS ESTIMATE

Lower Cox Brook Covered Bridge
Scoping Estimate Item List
Hoyle Tanner Project No. 23.904201.14
VTrans Project Northfield BO CVBR(8)

1011 - ROADWAY CATEGORY

ITEM NO.	ITEM DESCRIPTION	Unit	Quantity				Unit Cost	Cost			
			H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)		H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)
201.1000	Clearing and Grubbing, Including Individual Trees and Stumps	LS	1	1	1	1	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00
204.2100	Trench Excavation of Rock	CY	75	75	75	75	$ 175.00	$ 13,125.00	$ 13,125.00	$ 13,125.00	$ 13,125.00
204.3000	Granular Backfill for Structures	CY	75	75	75	75	$ 85.00	$ 6,375.00	$ 6,375.00	$ 6,375.00	$ 6,375.00
210.1000	Coarse-Milling, Bituminous Pavement	SY	125	125	125	125	$ 40.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00
301.2500	Subbase of Crushed Gravel, Coarse Graded	CY	325	325	325	325	$ 75.00	$ 24,375.00	$ 24,375.00	$ 24,375.00	$ 24,375.00
401.1000	Aggregate Surface Course	CY	50	50	50	50	$ 75.00	$ 3,750.00	$ 3,750.00	$ 3,750.00	$ 3,750.00
404.1100	Tack Coat, Emulsified Asphalt	CWT	90	90	90	90	$ 45.00	$ 4,050.00	$ 4,050.00	$ 4,050.00	$ 4,050.00
406.0230	Bituminous Concrete Pavement, Type IIS, QA Tier III	TON	180	180	180	180	$ 155.00	$ 27,900.00	$ 27,900.00	$ 27,900.00	$ 27,900.00
406.0430	Bituminous Concrete Pavement, Type IVS, QA Tier III	TON	110	110	110	110	$ 190.00	$ 20,900.00	$ 20,900.00	$ 20,900.00	$ 20,900.00
541.2200	Concrete, Class B	CY	25	25	25	25	$ 1,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00
608.2501	All-Purpose Excavator Rental, Type I	HR	10	10	10	10	$ 150.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
609.1500	Dust Control with Calcium Chloride	TON	0.5	1	1	1	$ 190.00	$ 95.00	$ 95.00	$ 95.00	$ 95.00
613.1002	Stone Fill, Type II	CY	100	100	100	100	$ 95.00	$ 9,500.00	$ 9,500.00	$ 9,500.00	$ 9,500.00
621.2600	Steel Backed Timber Guardrail	LF	320	320	320	320	$ 410.00	$ 131,200.00	$ 131,200.00	$ 131,200.00	$ 131,200.00
621.0100	Removal of Guardrail	LF	110	110	110	110	$ 5.00	$ 550.00	$ 550.00	$ 550.00	$ 550.00
633.1000	CPM Schedule	EACH	8	8	8	8	$ 650.00	$ 5,200.00	$ 5,200.00	$ 5,200.00	$ 5,200.00
635.1100	Mobilization/Demobilization	LS	1	1	1	1	-	$ 200,000.00	$ 200,000.00	$ 200,000.00	$ 210,000.00
641.1100	Traffic Control, All-Inclusive	LS	1	1	1	1	$ 24,000.00	$ 24,000.00	$ 24,000.00	$ 24,000.00	$ 24,000.00
649.3100	Geotextile Under Stone Fill	SY	135	135	135	135	$ 7.50	$ 1,012.50	$ 1,012.50	$ 1,012.50	$ 1,012.50
675.2000	Traffic Sign, Flat Sheet Aluminum	SF	45	45	45	45	$ 35.00	$ 1,575.00	$ 1,575.00	$ 1,575.00	$ 1,575.00
675.3410	Square Tube Sign Post and Anchor	LF	75	75	75	75	$ 25.00	$ 1,875.00	$ 1,875.00	$ 1,875.00	$ 1,875.00
675.5000	Sign Removal, Flat Sheet Aluminum	EACH	6	6	6	6	$ 40.00	$ 240.00	$ 240.00	$ 240.00	$ 240.00
676.1000	Delineator with Steel Post	EACH	1	1	1	1	$ 170.00	$ 170.00	$ 170.00	$ 170.00	$ 170.00
							ROADWAY CATEGORY TOTAL:	**$ 522,392.50**	**$ 522,392.50**	**$ 522,392.50**	**$ 532,392.50**

1031 - TRAINING CATEGORY

ITEM NO.	ITEM DESCRIPTION	Unit	Quantity				Unit Cost	Cost			
			H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)		H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)
							TRAINING CATEGORY TOTAL:	**$0**	**$0**	**$0**	**$0**

1051 - EROSION CONTROL CATEGORY

ITEM NO.	ITEM DESCRIPTION	Unit	Quantity				Unit Cost	Cost			
			H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)		H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)
							EROSION CONTROL CATEGORY TOTAL:	**$ 50,000.00**	**$ 50,000.00**	**$ 50,000.00**	**$ 50,000.00**

	1211 - BRIDGE CATEGORY										
ITEM NO.	ITEM DESCRIPTION	Unit	Quantity				Unit Cost	Cost			
			H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)		H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)
204.2500	Structure Excavation	CY	75	75	75	75	$ 80.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00
204.3000	Granular Backfill for Structures	CY	75	75	75	75	$ 85.00	$ 6,375.00	$ 6,375.00	$ 6,375.00	$ 6,375.00
208.4000	Cofferdam	LS	1	1	1	1	$ 150,000.00	$ 150,000.00	$ 150,000.00	$ 150,000.00	$ 150,000.00
501.3700	Performance-Based Concrete, Class PCD	CY	15	15	15	15	$ 2,400.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00
501.3800	Performance-Based Concrete, Class PCS	CY	100	100	100	100	$ 1,750.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00
502.1000	Shoring Superstructure	LS	1	1	1	1	$ 225,000.00	$ 225,000.00	$ 225,000.00	$ 225,000.00	$ 225,000.00
506.6000	Structural Steel	LB	2500	2500	2500	2500	$ 10.00	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00
507.1100	Reinforcing Steel, Level I (Epoxy Coated)	LB	13000	13000	13000	13000	$ 5.00	$ 65,000.00	$ 65,000.00	$ 65,000.00	$ 65,000.00
507.1600	Drilling and Grouting Dowels	LF	110	110	110	110	$ 50.00	$ 5,500.00	$ 5,500.00	$ 5,500.00	$ 5,500.00
514.1000	Water Repellent, Silane	GAL	10	10	10	10	$ 130.00	$ 1,300.00	$ 1,300.00	$ 1,300.00	$ 1,300.00
522.2000	Structural Lumber and Timber, Untreated	MFBM	2.5	2.5	2.5	2.5	$ 20,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00
522.2000001	Rehabilitating Covered Bridge Superstructure	LS	1	1	1	1	$ 125,000.00	$ 125,000.00	$ 125,000.00	$ 125,000.00	$ 125,000.00
522.2000002	Timber Coating (Environmental Protection)	LS	1	1	1	1	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00
522.2000003	Timber Coating (Fire Retardant)	LS	1	1	1	1	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00
522.2000004	Timber Coating (Fungicide/Insecticide/Termicide)	LS	1	1	1	1	$ 21,000.00	$ 21,000.00	$ 21,000.00	$ 21,000.00	$ 21,000.00
522.2000005	Metal Roofing	SY	170	170	170	170	$ 185.00	$ 31,450.00	$ 31,450.00	$ 31,450.00	$ 31,450.00
522.2000006	Wood Epoxy Repairs	EA	12	12	12	12	$ 400.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00
522.2500	Structural Lumber and Timber, Treated	MFBM	2.8	2.8	2.8	2.8	$ 20,000.00	$ 56,000.00	$ 56,000.00	$ 56,000.00	$ 56,000.00
522.3000	Nonstructural Lumber, Untreated	MFBM	2.6	2.6	2.6	2.6	$ 12,000.00	$ 31,200.00	$ 31,200.00	$ 31,200.00	$ 31,200.00
522.4000	Structural Glued Laminated Timber	MFBM	9.8	10.8	10.3	11.4	$ 15,000.00	$ 147,000.00	$ 162,000.00	$ 154,500.00	$ 171,000.00
524.1100	Joint Sealer, Hot Poured	LF	45	45	45	45	$ 40.00	$ 1,800.00	$ 1,800.00	$ 1,800.00	$ 1,800.00
528.1000	One Lane Temporary Bridge	LS	1	1	1	1	$ 250,000.00	$ 250,000.00	$ 250,000.00	$ 250,000.00	$ 250,000.00
529.2000	Partial Removal of Structure	EA	1	1	1	1	$ 70,000.00	$ 70,000.00	$ 70,000.00	$ 70,000.00	$ 70,000.00
529.2500	Removal of Concrete or Masonry	CY	22	22	22	22	$ 4,500.00	$ 99,000.00	$ 99,000.00	$ 99,000.00	$ 99,000.00
613.1002	Stone Fill, Type II	CY	30	30	30	30	$ 100.00	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00
649.3100	Geotextile Under Stone Fill	SY	80	80	80	80	$ 6.00	$ 480.00	$ 480.00	$ 480.00	$ 480.00
							BRIDGE CATEGORY TOTAL:	**$ 1,606,905.00**	**$ 1,621,905.00**	**$ 1,614,405.00**	**$ 1,630,905.00**

	1999 - FULL C.E ITEMS CATEGORY										
ITEM NO.	ITEM DESCRIPTION	Unit	Quantity				Unit Cost	Cost			
			H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)		H15 (15-Ton)	HS15 (27-Ton)	H20 (20-Ton)	HS20 (36-Ton)
							FULL C.E. ITEMS TOTAL:	**$ 40,000.00**	**$ 40,000.00**	**$ 40,000.00**	**$ 40,000.00**
							ROADWAY:	$ 523,000.00	$ 523,000.00	$ 523,000.00	$ 533,000.00
							EROSION CONTROL:	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00
							BRIDGE:	$ 1,607,000.00	$ 1,622,000.00	$ 1,615,000.00	$ 1,631,000.00
							FULL CE ITEMS:	$ 40,000.00	$ 40,000.00	$ 40,000.00	$ 40,000.00
							CONSTRUCTION COSTS (SUBTOTAL):	$ 2,220,000.00	$ 2,235,000.00	$ 2,228,000.00	$ 2,254,000.00
							CONSTRUCTION ENGINEERING AND CONTINGENCIES (CEC) (25%):	$ 555,000.00	$ 559,000.00	$ 557,000.00	$ 564,000.00
							ACCELERATED PREMIUM:	$ -	$ -	$ -	$ -
							CONSTRUCTION TOTAL (w/CEC):	$ 2,775,000.00	$ 2,794,000.00	$ 2,785,000.00	$ 2,818,000.00
							PRELIMINARY ENGINEERING (25%):	$ 555,000.00	$ 559,000.00	$ 557,000.00	$ 564,000.00
							ROW:	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00
							TOTAL PROJECT COSTS:	**$ 3,355,000.00**	**$ 3,378,000.00**	**$ 3,367,000.00**	**$ 3,407,000.00**
							DESIGN LIFE (YEARS):	40	40	40	40
							ANNUALIZED COST:	$ 83,875.00	$ 84,450.00	$ 84,175.00	$ 85,175.00
							TOWN SHARE:	$ 167,750.00	$ 168,900.00	$ 168,350.00	$ 170,350.00
							TOWN %:	5%	5%	5%	5%

APPENDIX D

Wood Species Identification Report

Memorandum

Date: January 22, 2024

To: Josif Bicja, P.E.
Project Engineer
Hoyle, Tanner & Associates
150 Dow Street
Manchester, NH 03101

From: Douglas J. Gardner, Ph.D.
Consultant
PO Box 219
Eddington, Maine 04428
Email: douglasg@maine.edu

Subject: Identification of Lower Cox Brook Covered Bridge wood samples.

Following are my findings relative to the identification of the Lower Cox Brook Covered Bridge wood samples you sent to me in mid-January. I relied on my background in wood identification, The Wood Data Base (https://www.wood-database.com), and the Key to Gross Identification found in the Textbook of Wood Technology, 4th Edition by Panshin and De Zeeuw (ISBN 0-07-048441-4) in making my evaluations. Identification of the wood samples was made using a 12x Hand Lens.

Samples Identified

A summary of the wood species identified are listed in Table 1 along with comments related to the nature of the samples. The original wood species used (1872) consisted of Eastern Spruce (*Picea* spp), Eastern Hemlock (*Tsuga canadensis*), spp.) and Hard Maple (*Acer saccharum*). The recent repairs to the deck included southern pine. More details about each sample are described below.

Table 1. Summary of wood species identified comprising wooden bridge members.

Sample Label	Wood Species	Comments
#1 – Rafter Support Beam	Eastern Spruce	
#2 – Cross Beam South Truss Node 5	Eastern Spruce	
#3 – Knee Brace North Truss Node 3	Hemlock	
#4 – Deck	Southern Pine	
#5 – Truss Diagonal NW End	Eastern Spruce	
#6 – Roof Rafter	Eastern Spruce	
#7 – Truss Vertical South Truss Node 5	Hard Maple	Interesting to see this in such an application
#8 – Truss Vertical South Truss Node 4	Eastern Spruce	
#9 – Bottom Chord North Truss Node 6	Eastern Spruce	

1. Samples 1, 2, 5, 6, 8, 9 Eastern Spruce (*Picea* spp.): straight grained and exhibited a gradual transition from earlywood to latewood in the growth increments. Presence of resin canals.

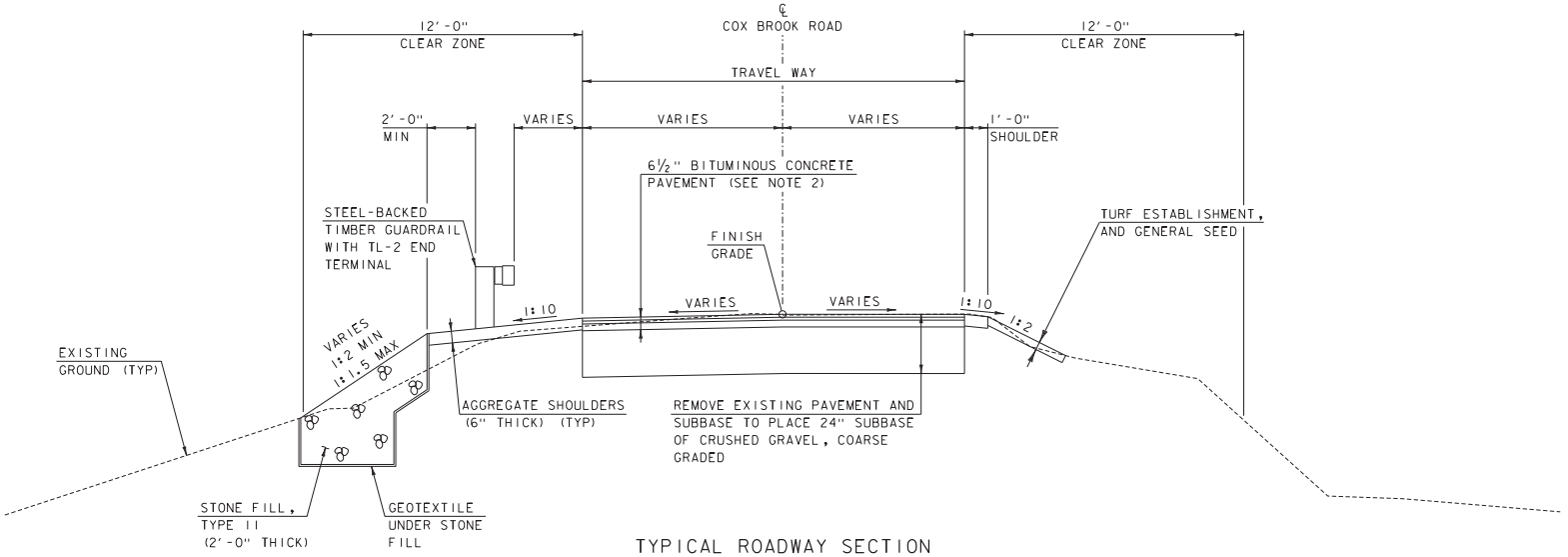
2. Sample 3 Eastern Hemlock (Tsuga canadensis): wood tended to be brittle and exhibited an abrupt transition from early wood to latewood in the growth increments.

3. Sample 4 Southern Pine (*Pinus* spp.) dense wood with abrupt transition from earlywood to latewood, resin canals apparent to naked eye.

4. Sample 7 Hard Maple (*Acer saccharum*): diffuse porous hardwood, with rays visible with 12x hand lense.

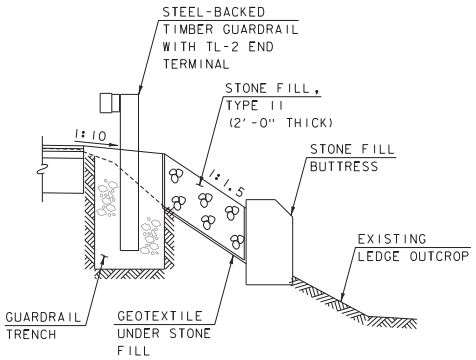
APPENDIX E

Plans of Proposed Improvements



TYPICAL ROADWAY SECTION

SCALE: ⅜" = 1'-0"



GUARDRAIL TRENCH SECTION

SCALE: ⅜" = 1'-0"

MATERIAL TOLERANCES (IF USED ON PROJECT)	
SURFACE	
- PAVEMENT (TOTAL THICKNESS)	+/- ¼"
- AGGREGATE SURFACE COURSE	+/- ½"
SUBBASE	+/- 1"
SAND BORROW	+/- 1"

NOTES

1. ROADWAY TYPICAL SECTION IS A GENERAL REPRESENTATION OF TYPICAL ROADWAY MATERIALS AND SLOPES. REFER TO THE LAYOUT SHEET FOR LOCATION OF GUARDRAIL AND SLOPE TIE IN LOCATIONS.

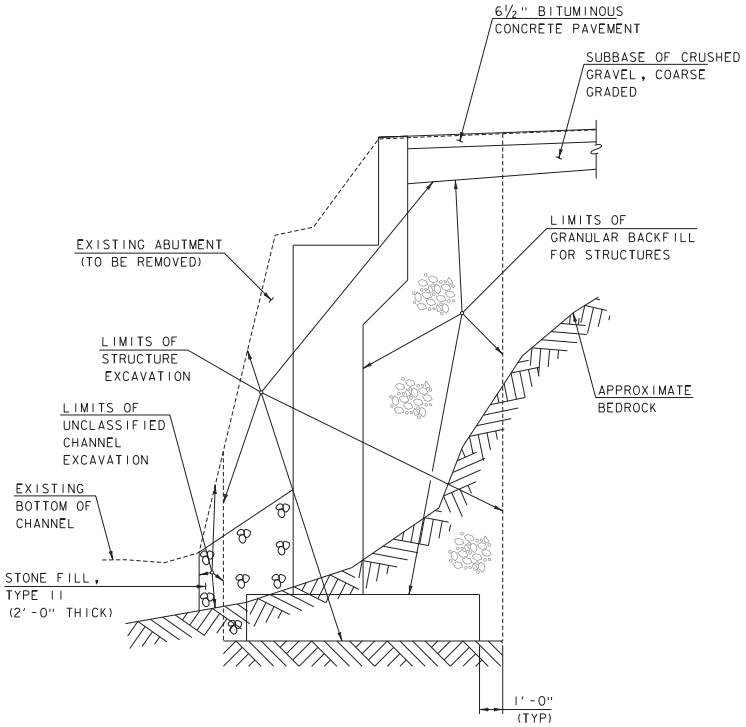
2. 6½" BITUMINOUS CONCRETE PAVEMENT SHALL CONSIST OF THE FOLLOWING:
   1½" TYPE IVS WEARING COURSE OVER
   1½" TYPE IVS BINDER COURSE
   3½" TYPE IIS BASE COURSE

HOYLE TANNER

PROJECT NAME: NORTHFIELD
PROJECT NUMBER: BO CVBR(8)

FILE NAME: z22j414typ.dgn
PROJECT LEADER: J.BICJA
DESIGNED BY: P.DUSTIN
TYPICAL SECTIONS 1

PLOT DATE: 24-JAN-2026
DRAWN BY: P.DUSTIN
CHECKED BY: K.LAVIGNE
SHEET 1 OF 10

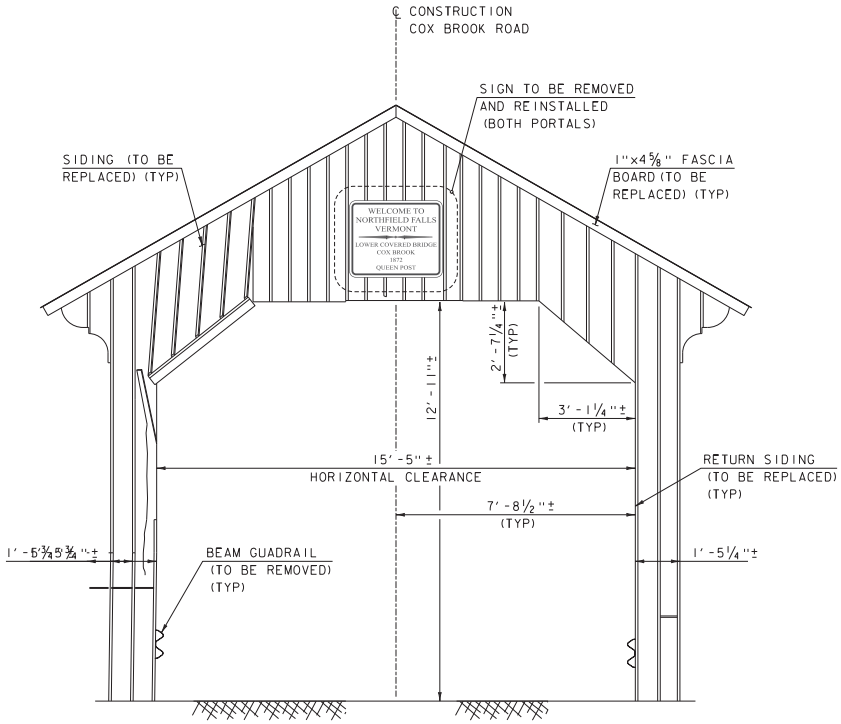


TYPICAL ABUTMENT EARTHWORK SECTION

SCALE: ⅜" = 1'-0"

HOYLE TANNER

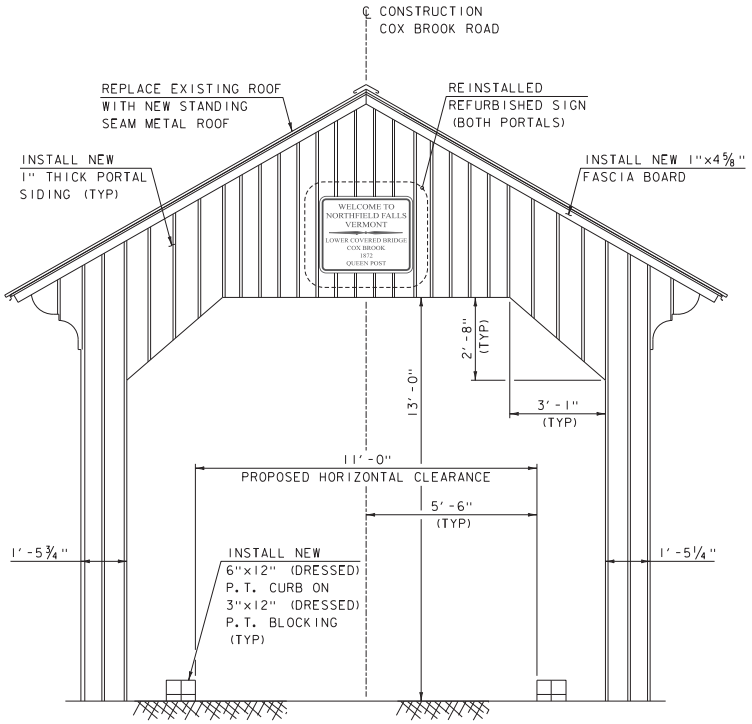
PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j414typ.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: P.DUSTIN	CHECKED BY: K.LAVIGNE
TYPICAL SECTIONS 2	SHEET 2 OF 10



EXISTING PORTAL ELEVATION

(WEST PORTAL SHOWN, EAST PORTAL SIMILAR)

SCALE: ½" = 1'-0"



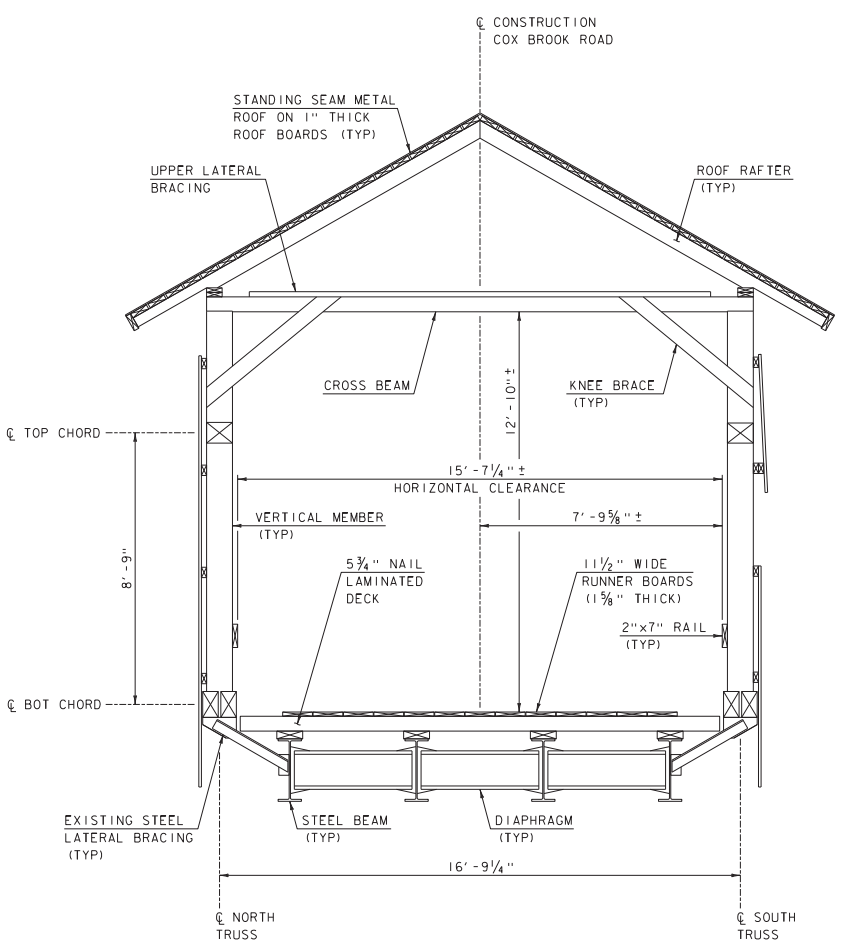
PROPOSED PORTAL ELEVATION

(WEST PORTAL SHOWN, EAST PORTAL SIMILAR)

SCALE: ½" = 1'-0"

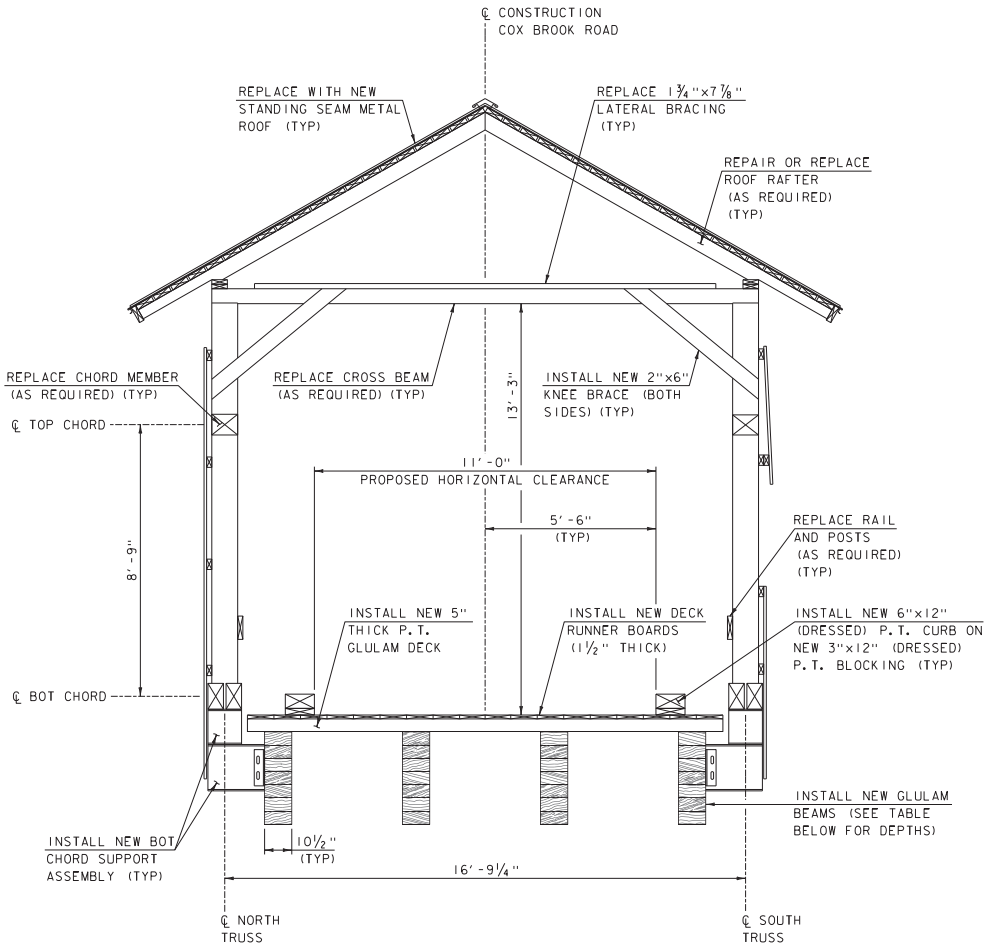
HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4supl.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: J.HOLLSTEIN	CHECKED BY: K.LAVIGNE
EXISTING AND PROPOSED PORTAL ELEVATIONS	SHEET 3 OF 10



EXISTING BRIDGE SECTION

SCALE: 1/2" = 1'-0"



PROPOSED BRIDGE SECTION

SCALE: 1/2" = 1'-0"

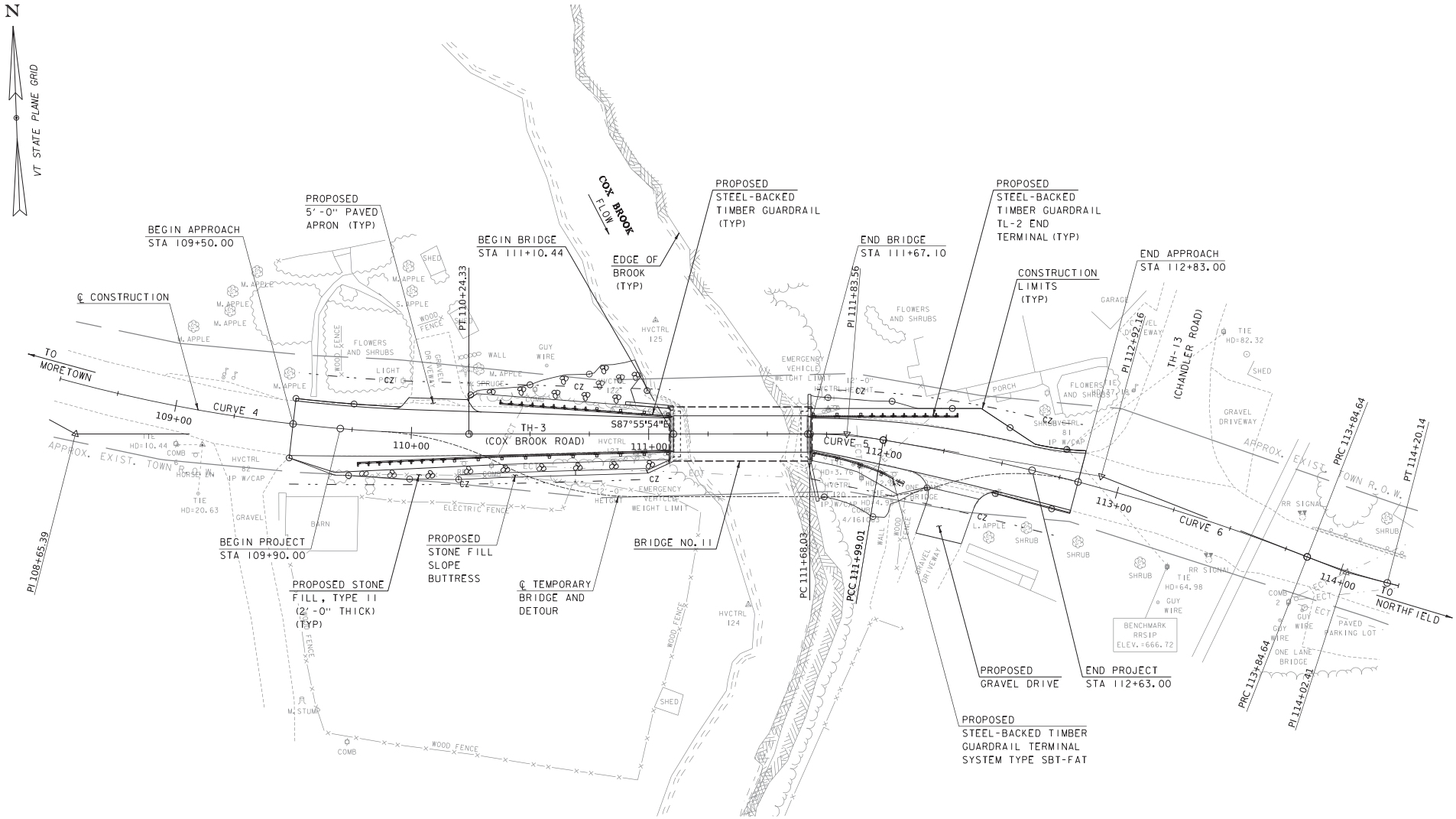
GLULAM BEAMS ALTERNATIVES	
DESIGN LIVE LOADING	BEAM DEPTH
ALTERNATIVE 1: H-15	27.5"
ALTERNATIVE 2: HS-15	33"
ALTERNATIVE 3: H-20	30.25"
ALTERNATIVE 4: HS-20	35.75"

HOYLE TANNER

PROJECT NAME: NORTHFIELD
PROJECT NUMBER: BO CVBR(8)

FILE NAME: z22j4l4sup2.dgn
PROJECT LEADER: J.BICJA
DESIGNED BY: J.HOLLSTEIN
EXISTING AND PROPOSED BRIDGE SECTIONS

PLOT DATE: 21-JAN-2026
DRAWN BY: P.DUSTIN
CHECKED BY: K.LAVIGNE
SHEET 4 OF 10



EXISTING BRIDGE INFORMATION
QUEEN POST COVERED BRIDGE
BUILT 1872, RECONSTRUCTED 1967, 1979
SINGLE SPAN, 56'-0" TRUSS LENGTH
STEEL BEAMS, 50'-0" SPAN LENGTH
15'-5" ROADWAY WIDTH
WOODEN DECK WITH RUNNER BOARDS
12'-11" MIN VERTICAL CLEAR
STONE ABUTMENTS ENCASED IN CONCRETE

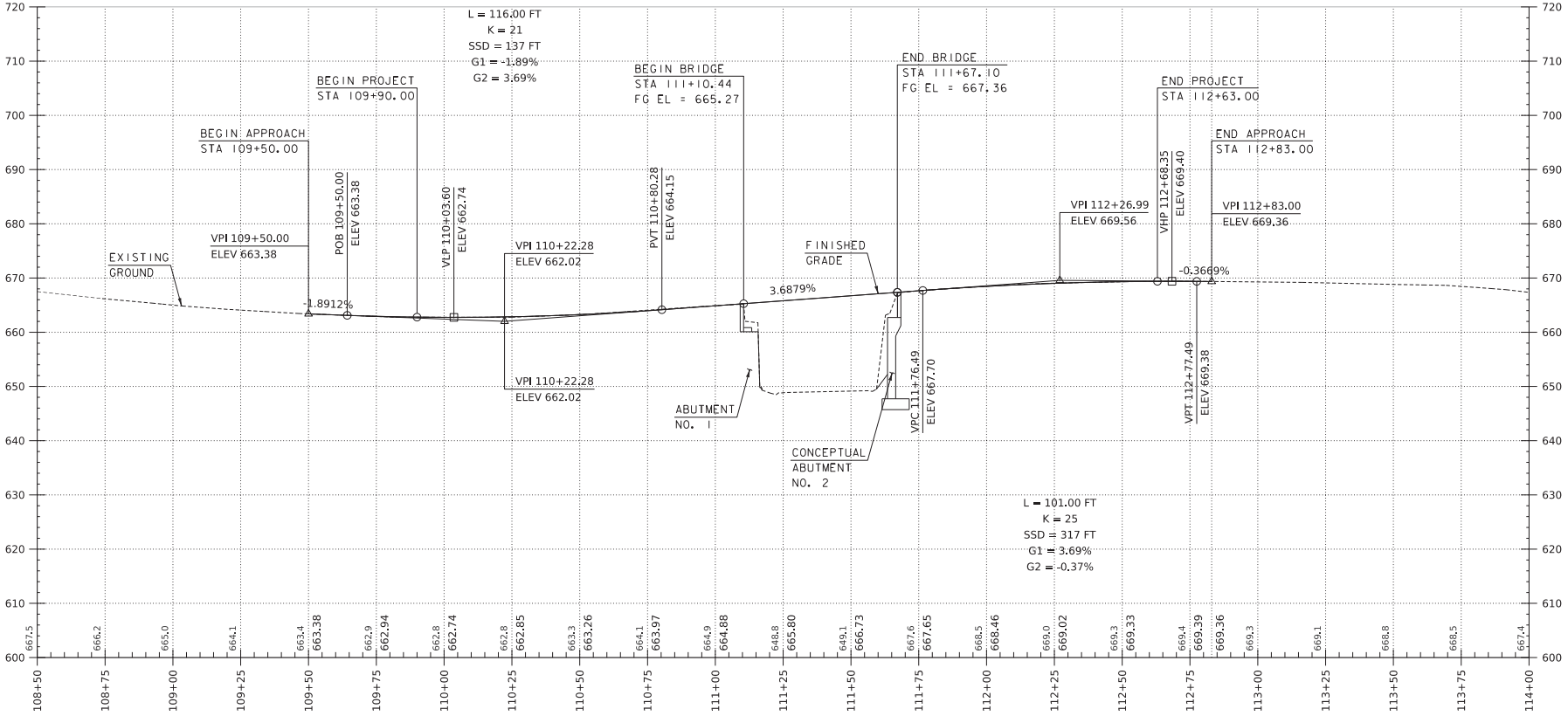
COX BROOK ROAD (TH-3) CURVE DATA

CURVE (4)	CURVE (5)	CURVE (6)
DELTA = 28°37'50"	DELTA = 09°26'28"	DELTA = 11°56'13"
D = 08°48'53"	D = 30°28'35"	D = 06°25'50"
R = 650.00'	R = 188.00'	R = 891.00'
T = 165.87'	T = 15.52'	T = 93.15'
L = 324.80'	L = 30.98'	L = 185.63'
E = 20.83'	E = 0.64'	E = 4.86'

SCALE 1" = 20'-0"
20 0 20

HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4bdr_lay.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: P.DUSTIN	CHECKED BY: K.LAVIGNE
RESOURCE SITE PLAN	SHEET 5 OF 10



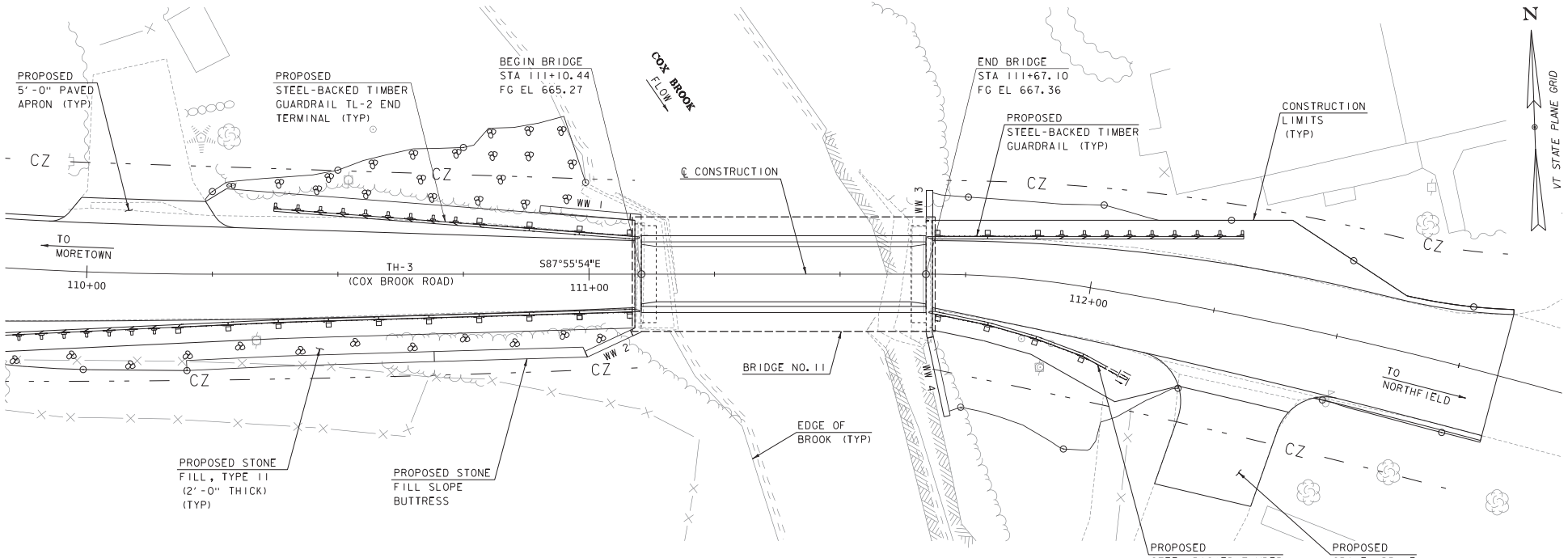
TH-3 (COX BROOK ROAD) PROFILE

SCALE: HORIZONTAL 1" = 20'-0"
VERTICAL 1" = 10'-0"

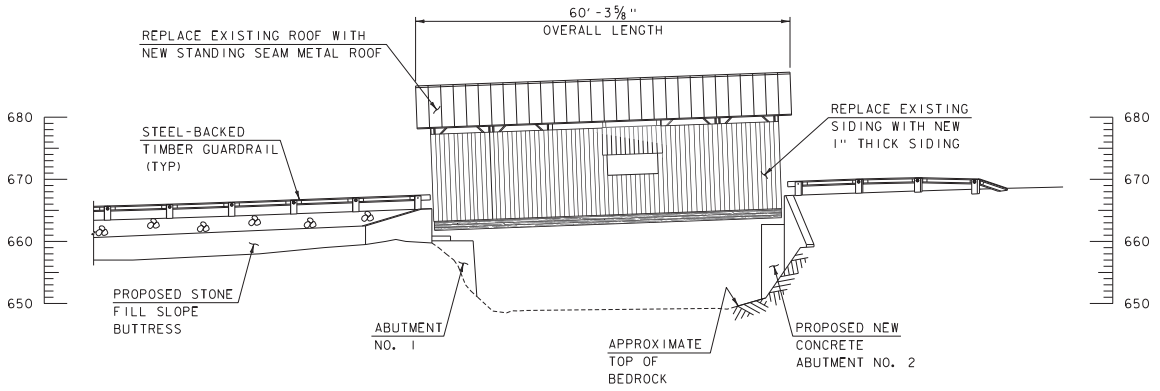
NOTE
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4pro.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: P.DUSTIN	CHECKED BY: K.LAVIGNE
PROFILE SHEET	SHEET 6 OF 10



PLAN
SCALE: 1" = 10'

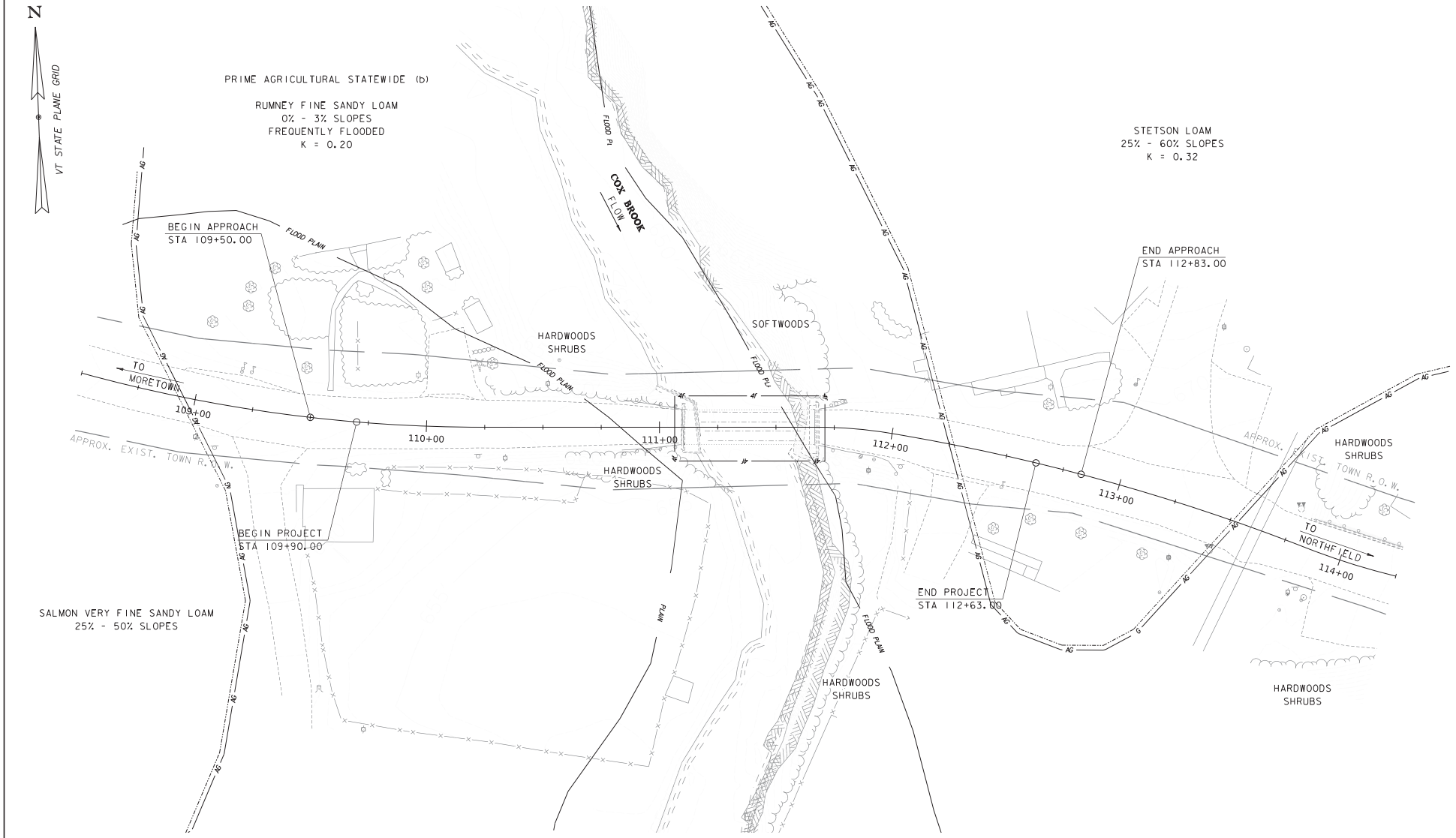


ELEVATION
SCALE: 1" = 10'

SCALE 1" = 10'-0"
10 0 10

HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4pe.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: J.HOLLSTEIN	CHECKED BY: J.BICJA
PLAN AND ELEVATION	SHEET 7 OF 10



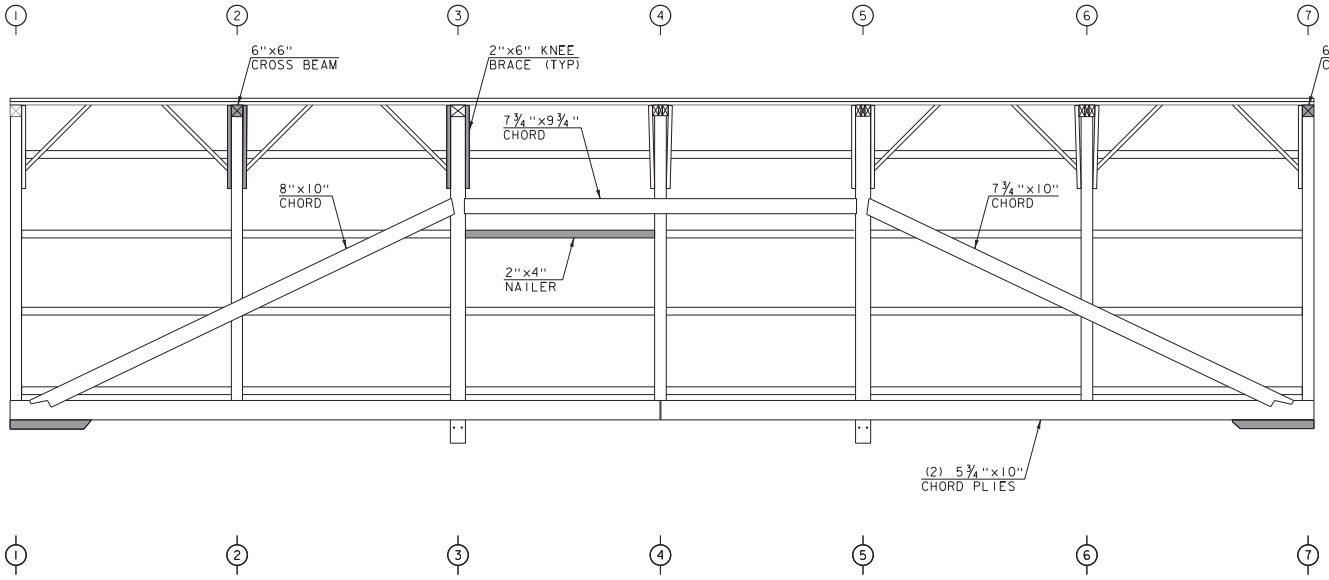
SCALE 1" = 20'-0"
20 0 20

HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4bdr_rsc.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: P.DUSTIN	CHECKED BY: K.LAVIGNE
RESOURCE SITE PLAN	SHEET 8 OF 10

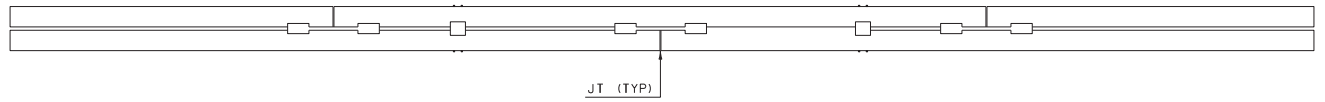
N

VT STATE PLANE GRID



NORTH TRUSS (LOOKING NORTH)

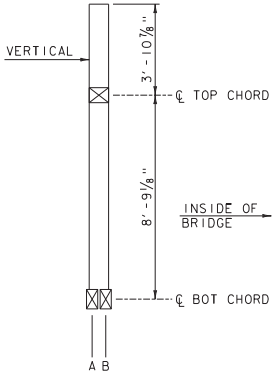
SCALE: 3/8" = 1'-0"



BOT CHORD PLAN

SCALE: 3/8" = 1'-0"

NTS (V)



TYPICAL TRUSS SECTION

SCALE: 3/8" = 1'-0"

LEGEND

PREDETERMINED MEMBER TO BE REPLACED

JT CHORD PLY BUTT JOINT

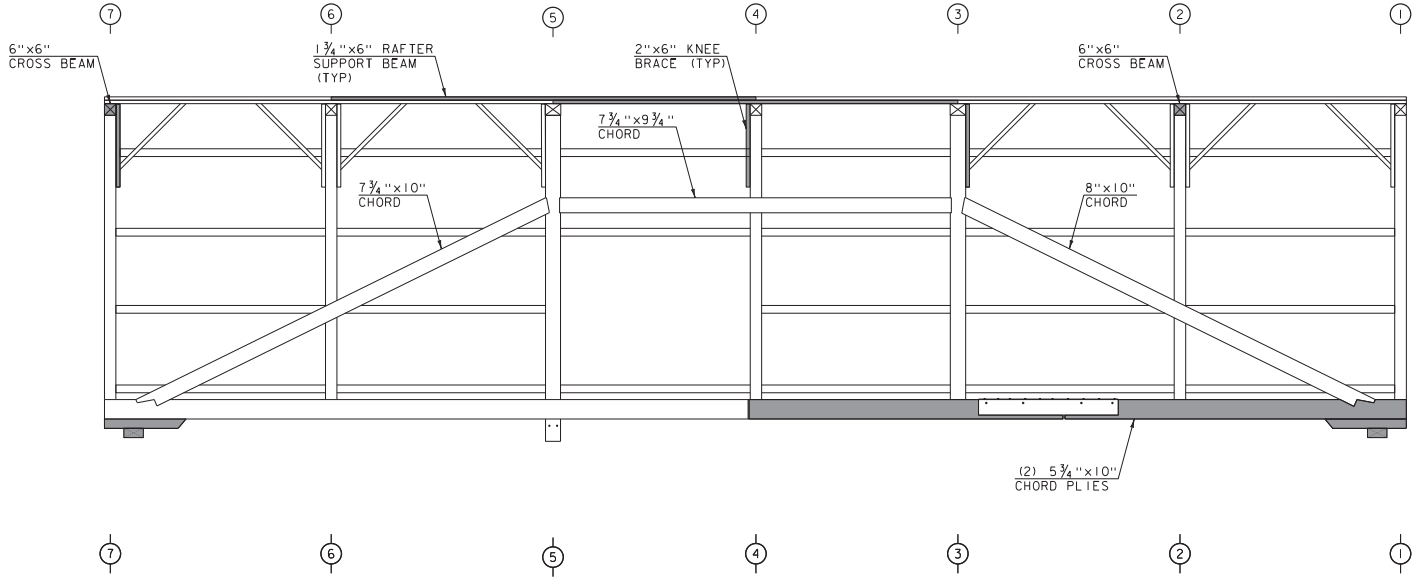
(X) TRUSS NODE LOCATION

HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4sup5.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: J.HOLLSTEIN	CHECKED BY: K.LAVIGNE
NORTH TRUSS PLAN AND ELEVATION	SHEET 9 OF 10

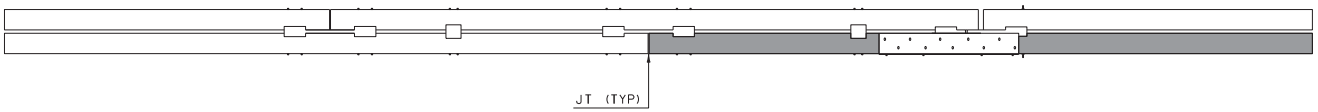
VT STATE PLANE GRID

N



SOUTH TRUSS (LOOKING SOUTH)

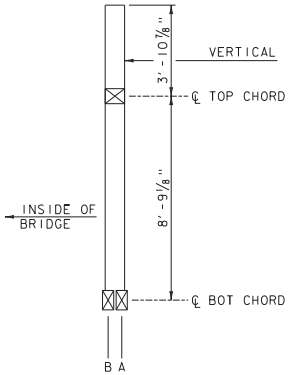
SCALE: 3/8" = 1'-0"



BOT CHORD PLAN

SCALE: 3/8" = 1'-0"

NTS (V)



TYPICAL TRUSS SECTION

SCALE: 3/8" = 1'-0"

LEGEND

PREDETERMINED MEMBER TO BE REPLACED

JT CHORD PLY BUTT JOINT

(X) TRUSS NODE LOCATION

HOYLE TANNER

PROJECT NAME:	NORTHFIELD
PROJECT NUMBER:	BO CVBR(8)
FILE NAME: z22j4l4sup5.dgn	PLOT DATE: 21-JAN-2026
PROJECT LEADER: J.BICJA	DRAWN BY: P.DUSTIN
DESIGNED BY: J.HOLLSTEIN	CHECKED BY: K.LAVIGNE
SOUTH TRUSS PLAN AND ELEVATION	SHEET 10 OF 10

APPENDIX F

Local Concerns Meeting Presentation

Local Concerns Meeting

Upper Cox Brook Covered Bridge
Northfield BO CVBR(7)
TH #3, Bridge No. 10 over Cox Brook

Lower Cox Brook Covered Bridge
Northfield BO CVBR(8)
TH #3, Bridge No. 11 over Cox Brook

Northfield Falls Covered Bridge
Northfield BO CVBR(9)
TH #3, Bridge No. 15 over Cox Brook

HOYLE TANNER

VTrans Working to Get You There
Vermont Agency of Transportation

Presentation Outline

- Purpose & Need
- Location Map
- Existing Bridge Information
- Inspection Findings
- Rehabilitation & Traffic Control Alternatives
- Cultural & Natural Resources
- Abutters & Right-of-Way
- Next Steps
- Anticipated Schedule
- Your Input is Needed

Purpose and Need

Purpose

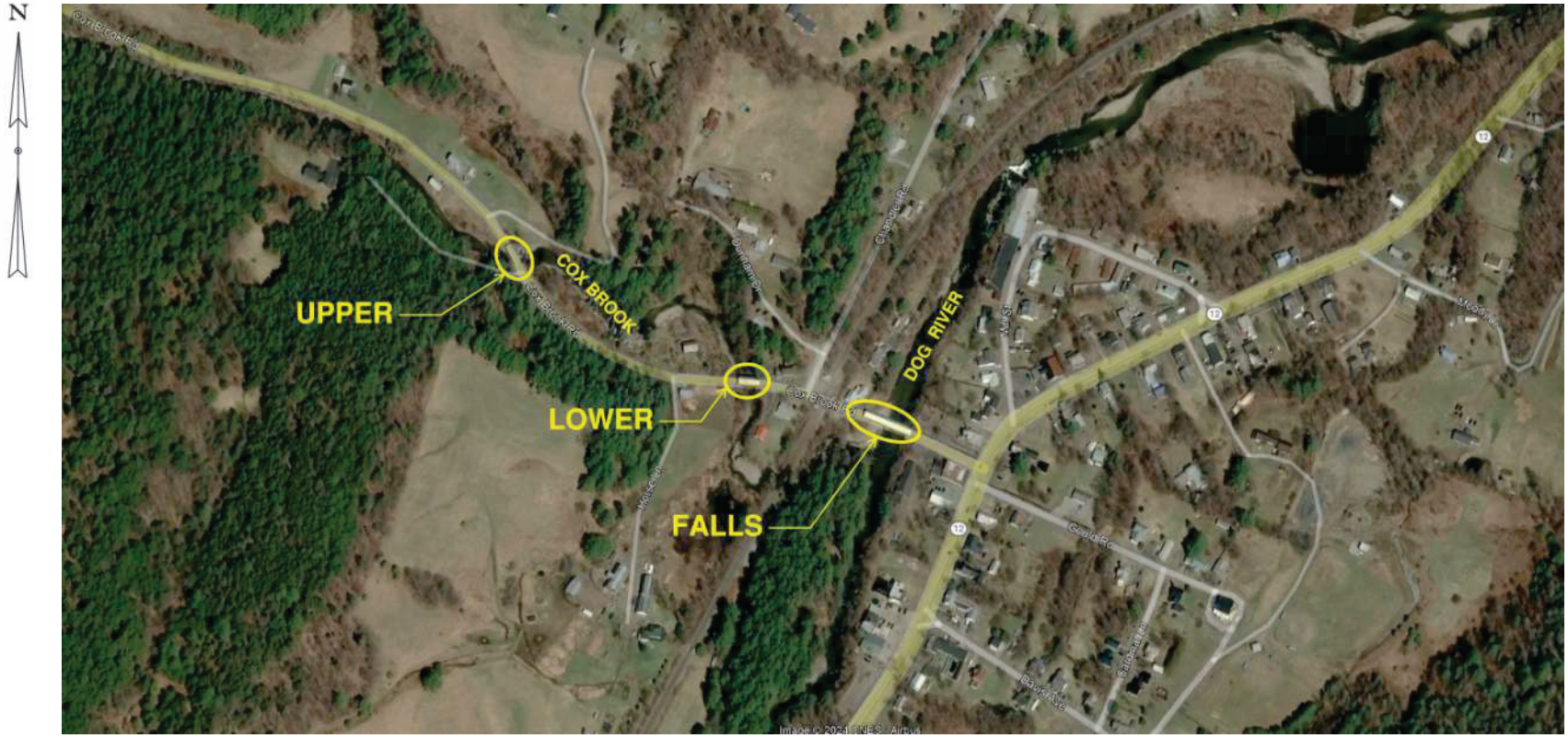
- Provide safe crossings over Cox Brook & Dog River for traveling public
- Address structural deficiencies & ongoing deterioration
- Extend bridges' service life

Need

- Bridges require rehabilitation to continue to meet the needs of the community

Community Needs and Considerations

Location Map



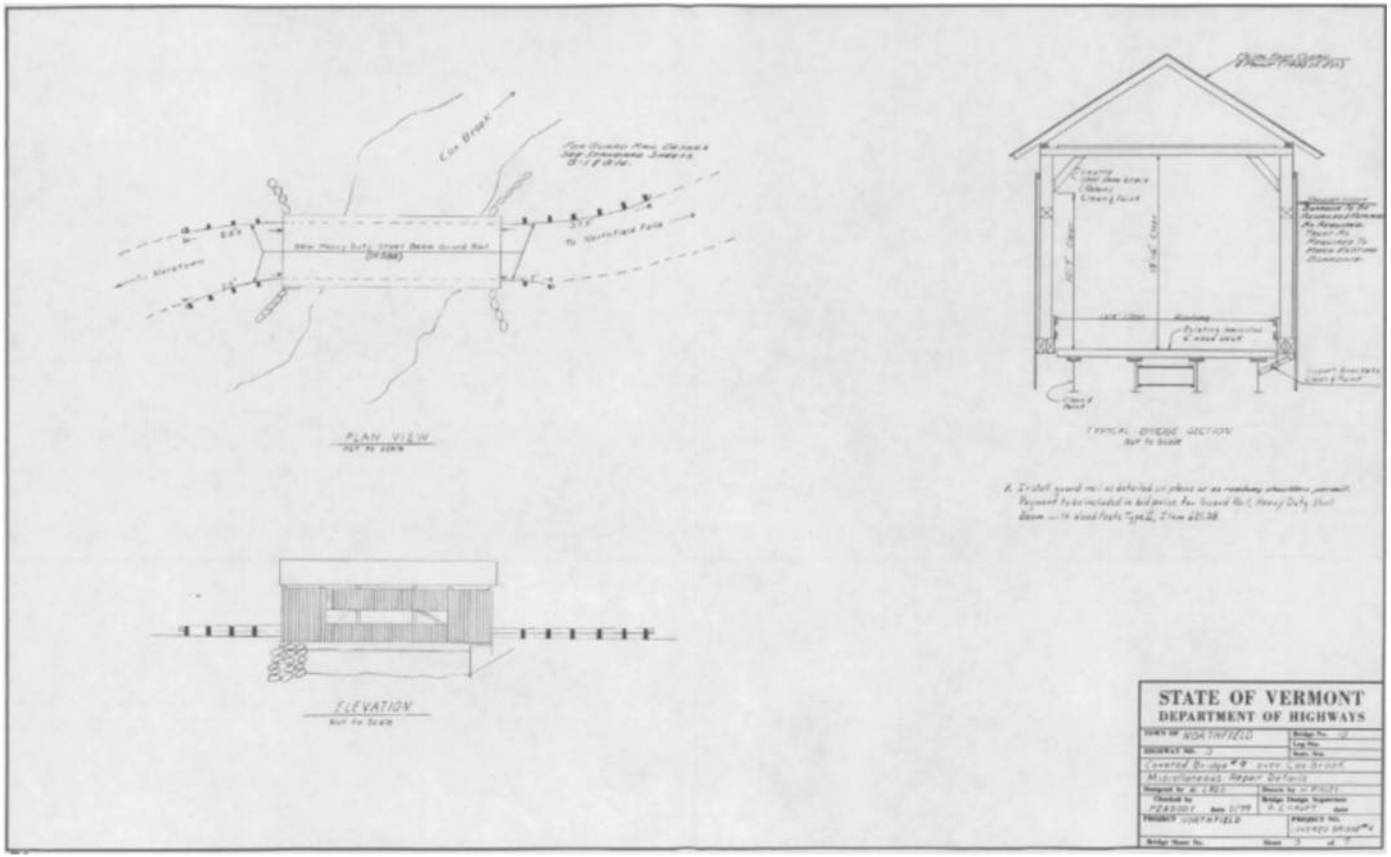
Upper Cox Brook Covered Bridge

HOYLE TANNER

Existing Bridge Information

- Bridge Constructed in 1872, Rehabilitated in 1967 & 1979
- Listed in National Register of Historic Places in 1974
- Queen Post Trusses
  - 52’ Long
  - 13’-6” Horizontal Clearance
  - 12’-0” Vertical Clearance
  - Weight Limit (6-Ton, Single Axle, 8-Ton Tandem, 11-Ton Gross)
- Substructures: Reinforced Concrete Abutments

Section and Elevation View



Inspection Findings

- Overall Bridge Condition = **4 (Poor)**
- Deck Condition = 5 (Fair)
- Superstructure Condition = 4 (Poor)
- Substructure Condition = 6 (Satisfactory)
- Channel Condition = 8 (Very Good)

Condition Rating	Description
9	Excellent Condition
8	Very Good Condition
7	Good Condition
6	Satisfactory Condition
5	Fair Condition
4	Poor Condition
3	Serious Condition
2	Critical Condition
1	Imminent Failure Condition

Metal Roof

- Leaks
- Screw Attachment

Roofboards and Rafters

- Splits
- Breaks
- Rot

Upper Bracing Members

- Splits
- Breaks
- Rot
- Impact Damage

Truss Members

- Splits
- Breaks
- Rot
- Weathering
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Weathering
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Weathering
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Weathering
- High Moisture Content

Steel Beams

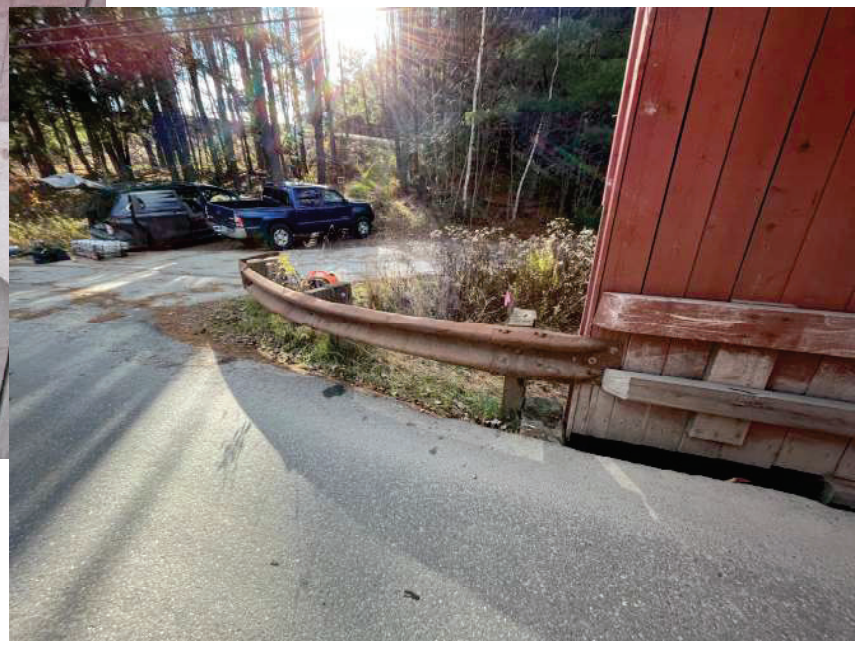
- Rust Holes
- Advanced Corrosion

Portals

- Breaks
- Impact Damage

Approach Railing

- Extensive Corrosion
- Rust Holes
- Rotted Wood Posts
- Impact Damage



Abutments

- Voids
- Spalling
- Exposed Rebar

Questions on Upper Cox Brook Inspection Findings?

HOYLE TANNER

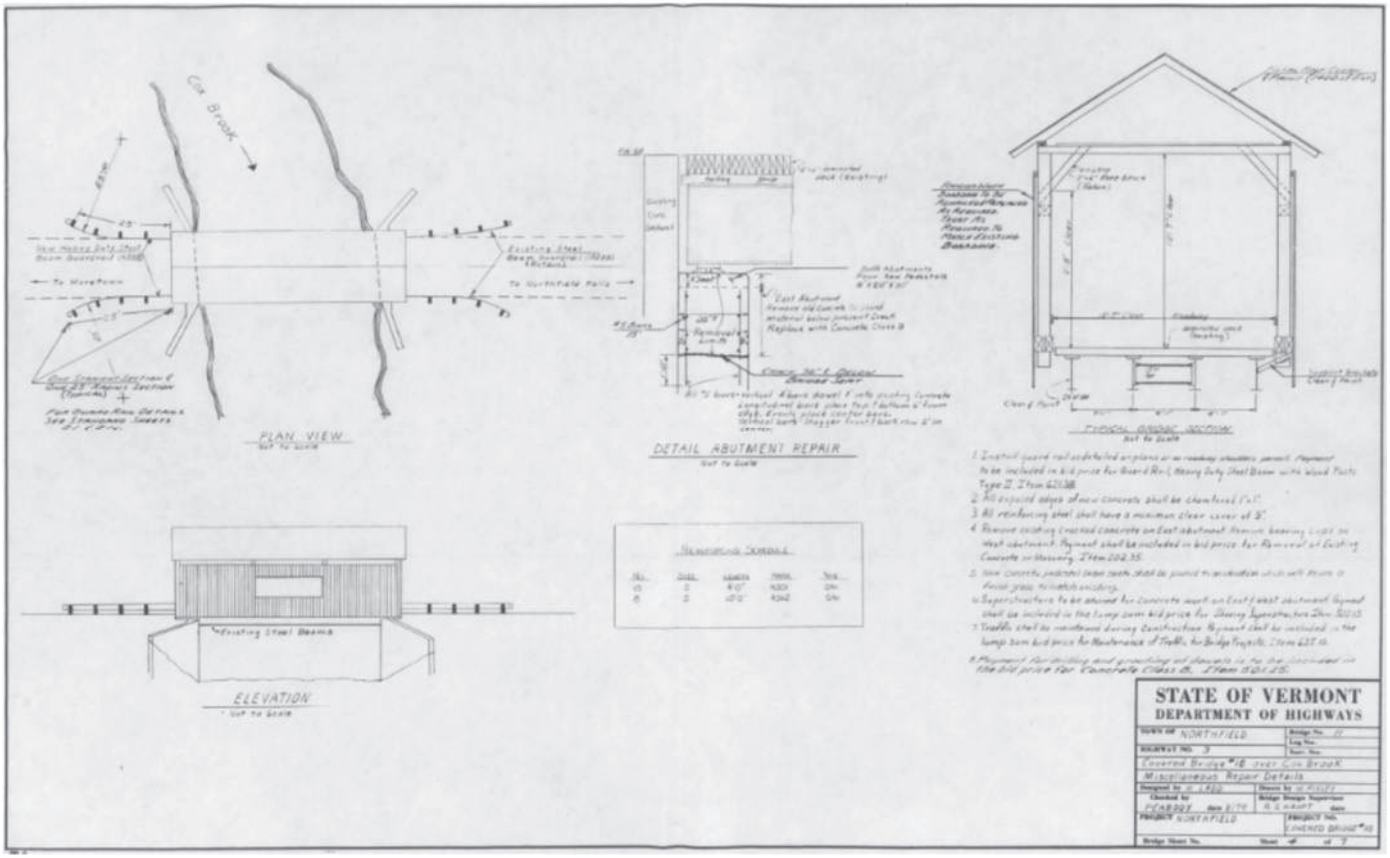
Lower Cox Brook Covered Bridge

HOYLE TANNER

Existing Bridge Information

- Bridge Constructed in 1872, Rehabilitated in 1967 & 1979
- Listed in National Register of Historic Places in 1974
- Queen Post Trusses
  - 57’ Long
  - 15’-4” Horizontal Clearance
  - 12’-0” Vertical Clearance
  - Weight Limit (12-Ton, Single Axle, 15-Ton Tandem, 21-Ton Gross)
- Substructures: Concrete Faced Stone Abutments

Section and Elevation View



Inspection Findings

- Overall Bridge Condition = **4 (Poor)**
- Deck Condition = 5 (Fair)
- Superstructure Condition = 4 (Poor)
- Substructure Condition = 5 (Fair)
- Channel Condition = 7 (Good)

Condition Rating	Description
9	Excellent Condition
8	Very Good Condition
7	Good Condition
6	Satisfactory Condition
5	Fair Condition
4	Poor Condition
3	Serious Condition
2	Critical Condition
1	Imminent Failure Condition

Metal Roof

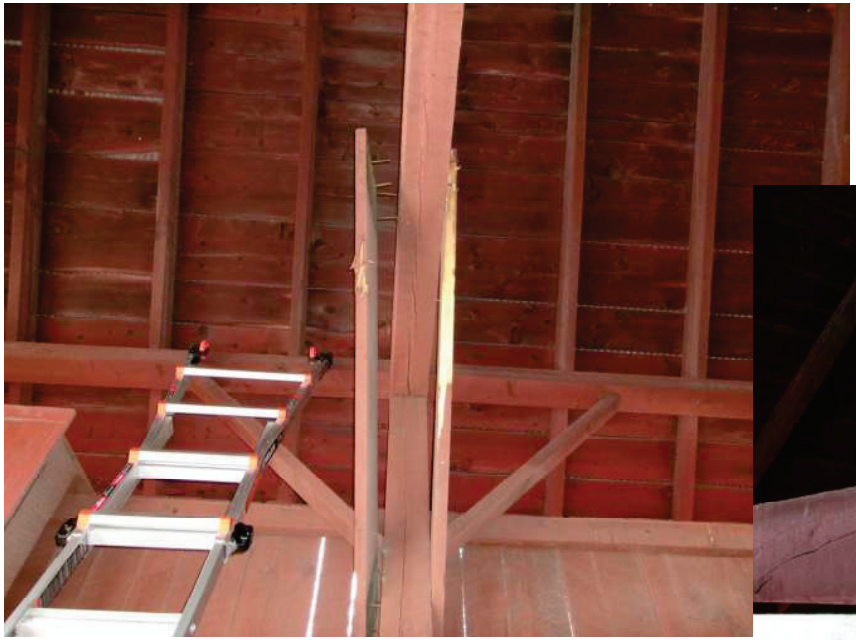
- Rusting
- Leaks
- Nail Attachment

Roofboards and Rafters

- Splits
- Breaks
- Rot
- Insect Damage

Upper Bracing Members

- Splits
- Breaks
- Rot
- Impact Damage



Truss Members

- Splits
- Breaks
- Rot
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- High Moisture Content

Steel Beams

- Rust Holes
- Advanced Corrosion

Steel Beams (Continued)

- Rust Holes
- Advanced Corrosion

Approaches

- Drainage Issues
- Ponding

Deck

- Breaks
- Poor Attachment

Abutments

- Voids
- Spalling
- Exposed Rebar

Abutments

- Voids
- Spalling
- Exposed Rebar
- CMU Truss Bearings

Questions on Lower Cox Brook Inspection Findings?

HOYLE TANNER

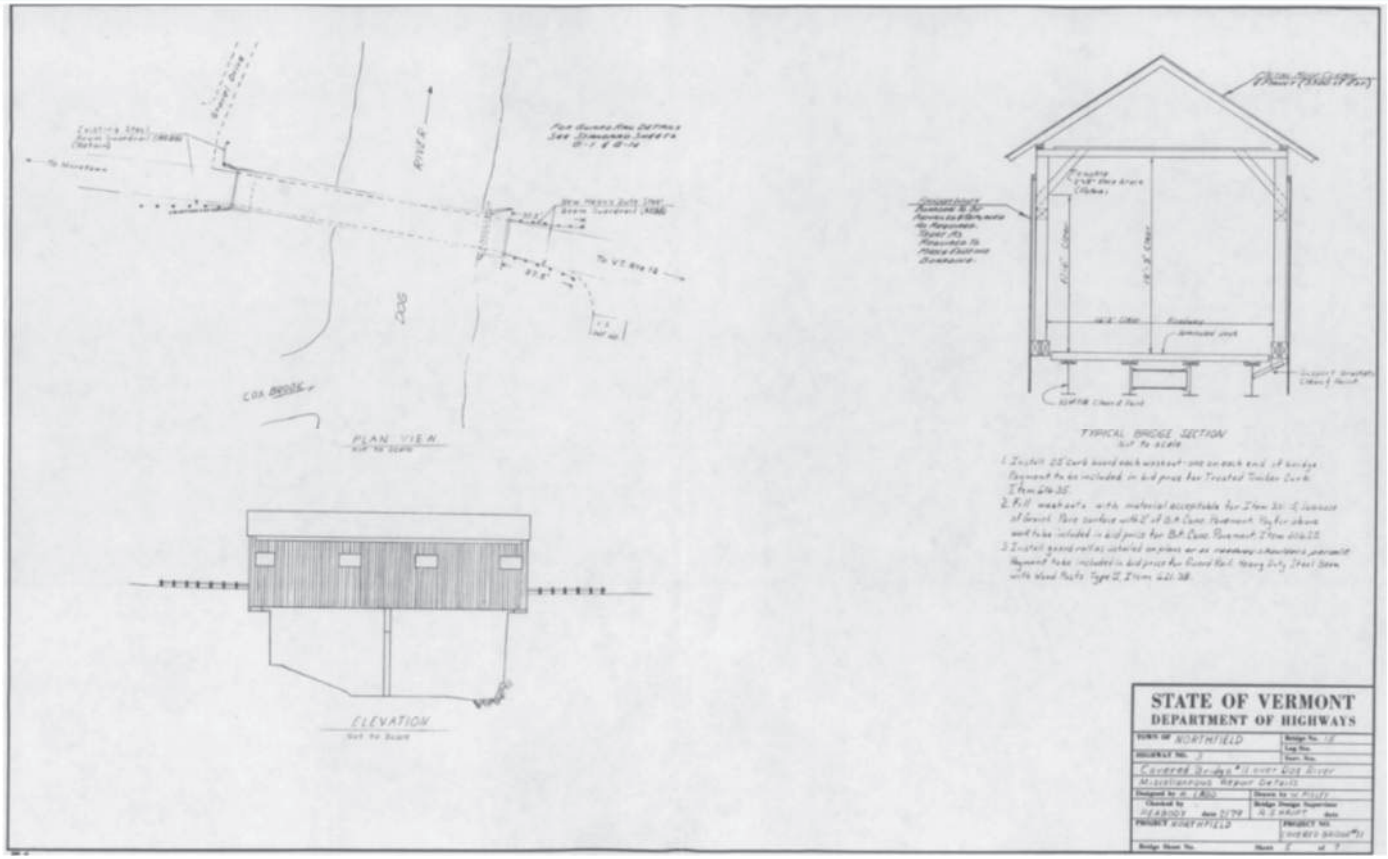
Northfield Falls Covered Bridge

HOYLE TANNER

Existing Bridge Information

- Bridge Constructed in 1872, Rehabilitated in 1942, 1968 & 1979
- Listed in National Register of Historic Places in 1974
- Town Lattice Trusses
  - 137’ Long
  - 16’-0” Horizontal Clearance
  - 12’-0” Vertical Clearance
  - Posted Weight Limit 10-Ton
- Substructures: Reinforced Concrete Pier, Stone and Concrete Abutments

Section and Elevation View



Inspection Findings

- Overall Bridge Condition = **4 (Poor)**
- Deck Condition = 5 (Fair)
- Superstructure Condition = 5 (Fair)
- Substructure Condition = 4 (Poor)
- Channel Condition = 8 (Very Good)

Condition Rating	Description
9	Excellent Condition
8	Very Good Condition
7	Good Condition
6	Satisfactory Condition
5	Fair Condition
4	Poor Condition
3	Serious Condition
2	Critical Condition
1	Imminent Failure Condition

Roofboards and Rafters

- Splits
- Breaks
- Rot
- Insect Damage

Upper Bracing Members

- Splits
- Breaks
- Rot
- Impact Damage

Upper Bracing Members (Continued)

- Splits
- Breaks
- Rot
- Impact Damage

Truss Members

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Truss Members (Continued)

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Steel Beams

- Rusting
- Advanced Corrosion

Steel Beams (Continued)

- Rusting
- Advanced Corrosion

Access

- Oversized Vehicles

Approaches

- Drainage Issues
- Ponding

Substructure

- Voids
- Spalling
- Exposed Rebar

Substructure

- Voids
- Spalling
- Exposed Rebar

Substructure

- Voids
- Spalling
- Exposed Rebar

Substructure

- Voids
- Spalling
- Exposed Rebar
- CMU Truss Bearings

Questions on Northfield Falls Inspection Findings?

HOYLE TANNER

Rehabilitation Alternatives Analysis

- Bridge Rehabilitations are feasible based on:
  - Current conditions of bridges
  - Deterioration types and levels of section losses observed
  - Expected remaining service lives
- Rehabilitation will extend service lives
- Bridge rehabilitation alternatives analysis will consider and evaluate H-15 (15-Ton) and H-20 (20-Ton) Design Vehicle

Rehabilitation Alternatives Analysis

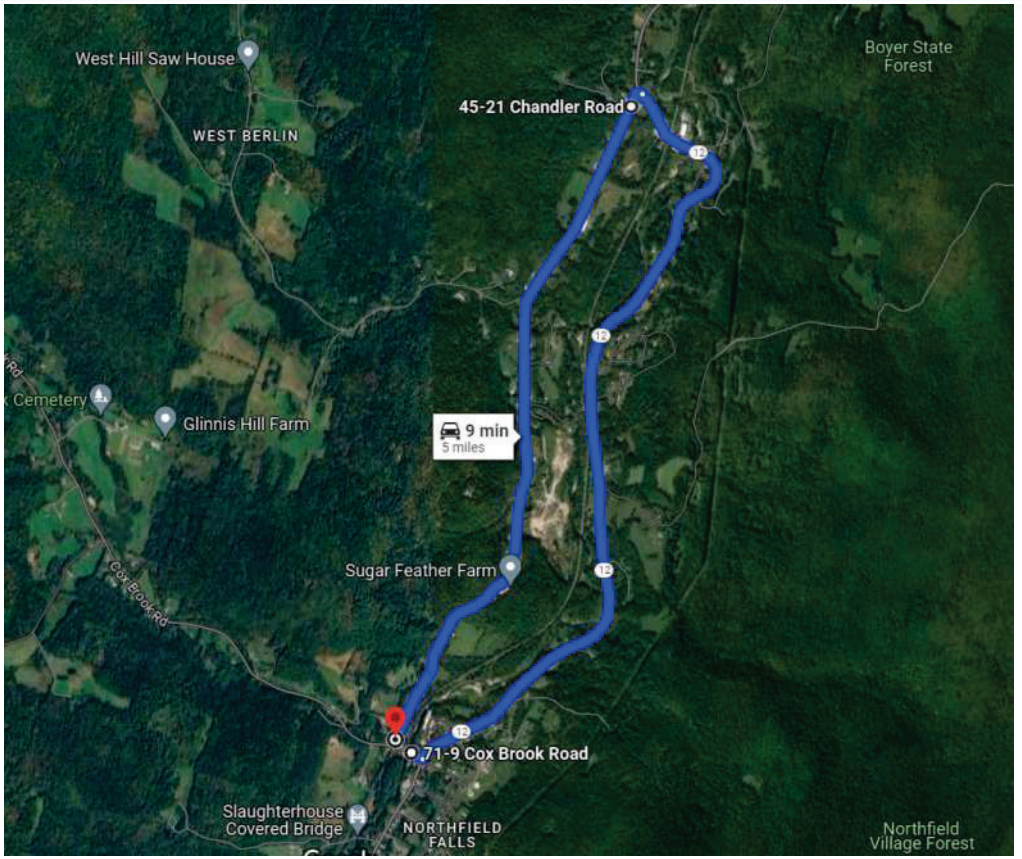
- Rehabilitation alternatives evaluation will include:
  - Initial Construction Cost
  - Fire Protection
  - Lighting
  - Traffic Impact
  - Public Safety
  - Environmental Impacts
  - Property Impacts
  - Extending Remaining Service Life
  - Public Input

Traffic Control Alternatives

- Phased construction
  - One lane of alternating two-way traffic
  - Not Feasible – not wide enough
- Temporary bridge
  - Not Feasible – not enough area adjacent to bridge locations
- Bridge closure with off-site detour

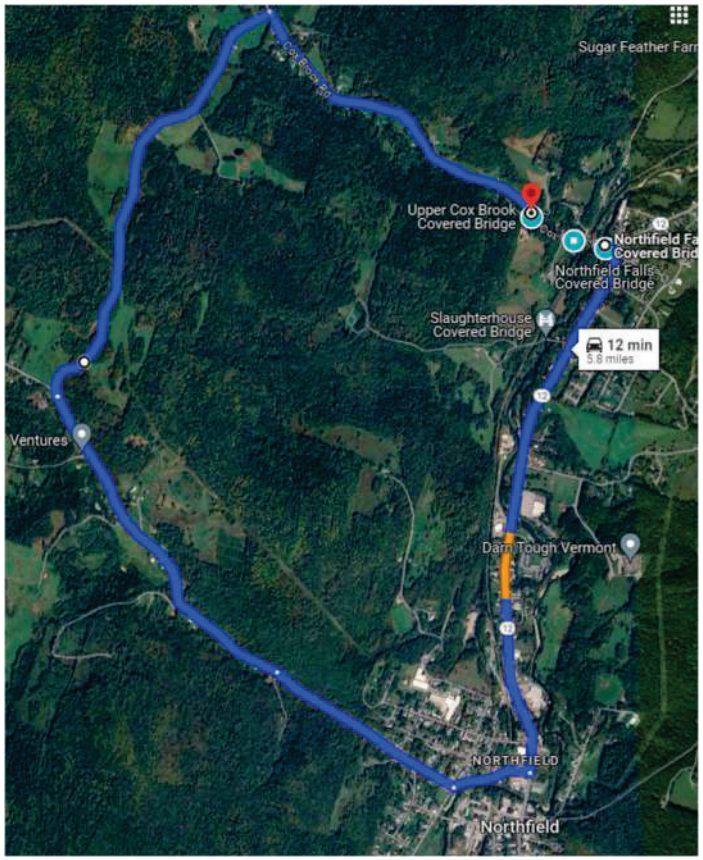
Traffic Control Alternatives

- Northern Detour
  - VT Route 12 to Chandler Rd to Cox Brook Road (5 miles, 9 minutes)



Traffic Control Alternatives

- Southern Detour
  - VT Route 12 to Water St to Union St to Aseltine Road to Cox Brook Road (6 miles, 12 minutes)



Cultural & Natural Resources

- Project must follow Section 106 of the National Historic Preservation Act
- Section 106 requires consideration of cultural resources, including:
  - Historic Buildings
  - Structures
  - Archaeological Deposits
- Coordination with State Historic Preservation Office (SHPO) and Historic Covered Bridge Preservation Committee (HCBPC)
- Natural Resources
  - Check project limits for natural resources

Right-of-Way

- Currently do not anticipate any property rights needed
- Temporary easements for construction access will be required

Next Steps

- Evaluate rehabilitation alternatives
- HCBPC presentation to get input & comments
- Hold Public Information Meeting to present recommended rehabilitation alternative
- Complete National Environmental Policy Act (NEPA) Process for environmental permitting
- Complete Scoping Report
- Develop Contract Plans & Documents

Anticipated Schedule

Public Input

- Abutter concerns
- Emergency response routes
- Bridge usage
- Local events and impacts
- Bridge safety concerns
- Other concerns

HOYLE TANNER

APPENDIX G

Alternatives Meeting Presentation

APPENDIX H

HCBPC Alternatives Presentation Meeting and Notes

HCBPC Alternative Meeting

Upper Cox Brook Covered Bridge
Northfield BO CVBR(7)
TH #3, Bridge No. 10 over Cox Brook

Lower Cox Brook Covered Bridge
Northfield BO CVBR(8)
TH #3, Bridge No. 11 over Cox Brook

Northfield Falls Covered Bridge
Northfield BO CVBR(9)
TH #3, Bridge No. 15 over Dog River

HOYLE TANNER

VTrans Working to Get You There
Vermont Agency of Transportation

Presentation Outline

- Purpose & Need
- Background
- Inspection Findings
- Rehabilitation Alternatives
- Right-of-Way, Utilities, Fire Protection
- Summary
- Questions

Purpose and Need

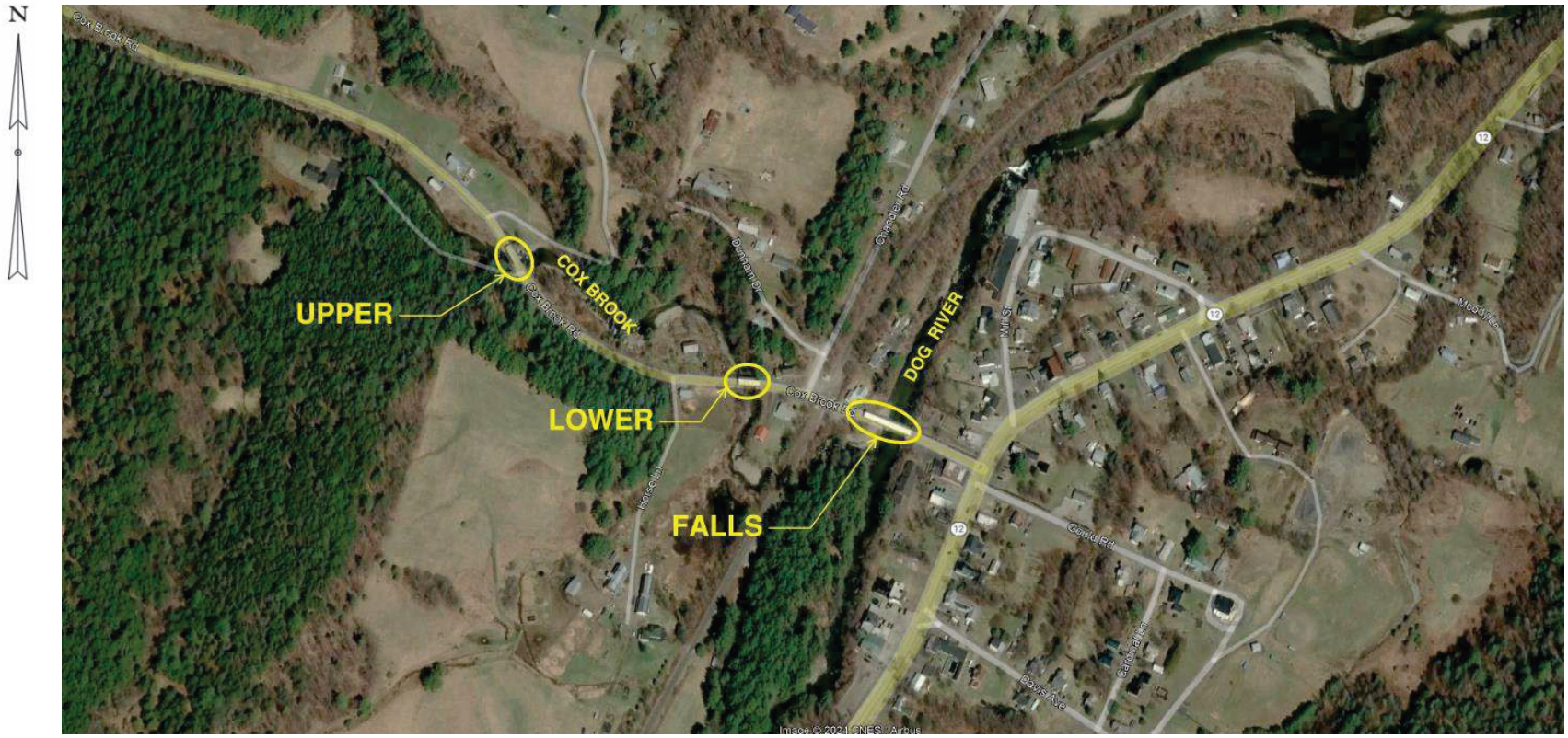
Purpose

- Provide safe crossings over Cox Brook & Dog River for traveling public
- Address structural deficiencies & ongoing deterioration
- Extend bridges' service life

Need

- Bridges require rehabilitation to continue to meet the needs of the community

Location Map



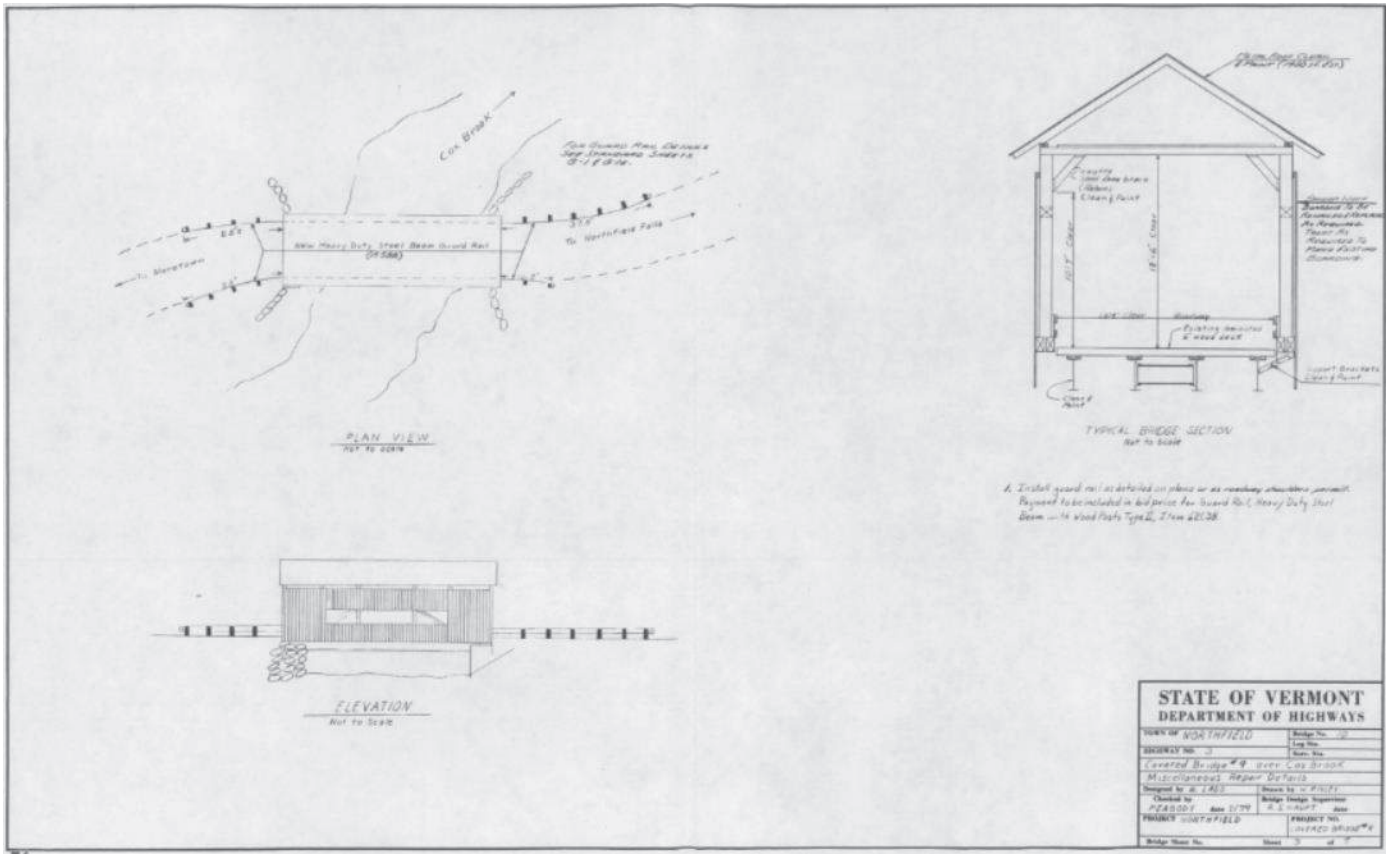
Upper Cox Brook Covered Bridge

HOYLE TANNER

Existing Bridge Information

- Bridge Constructed in 1872, Rehabilitated in 1967 & 1979
- Listed in National Register of Historic Places in 1974
- Queen Post Trusses
  - 52’ Long
  - 13’-6” Horizontal Clearance
  - 12’-0” Vertical Clearance (Posted)
  - Weight Limit (6-Ton Single Axle, 8-Ton Tandem, 11-Ton Gross)
- Substructures: Reinforced Concrete Abutments

Section and Elevation View



Inspection Findings

- Overall Bridge Condition = **4 (Poor)**
- Deck Condition = 5 (Fair)
- Superstructure Condition = 4 (Poor)
- Substructure Condition = 6 (Satisfactory)
- Channel Condition = 8 (Very Good)

Condition Rating	Description
9	Excellent Condition
8	Very Good Condition
7	Good Condition
6	Satisfactory Condition
5	Fair Condition
4	Poor Condition
3	Serious Condition
2	Critical Condition
1	Imminent Failure Condition

Metal Roof

- Leaks
- Screw Attachment

Roofboards & Rafters

- Splits
- Breaks
- Rot

Upper Bracing Members

- Splits
- Breaks
- Rot
- Impact Damage

Truss Members

- Splits
- Breaks
- Rot
- Weathering
- High Moisture Content

Steel Beams

- Rust Holes
- Advanced Corrosion

Portals

- Breaks
- Impact Damage

Approach Railing

- Extensive Corrosion
- Rust Holes
- Rotted Wood Posts
- Impact Damage

Abutments

- Voids
- Spalling
- Exposed Rebar

Rehabilitation Alternatives

- Bridge Rehabilitations are feasible based on:
  - Current condition of bridge
  - Deterioration types and levels of section losses observed
  - Expected remaining service life
- Rehabilitation includes:
  - Repair, strengthening, or replacement of bridge members
- Bridge Loads
  - Snow – 60 PSF Ground, 34 PSF Roof Applied
  - Wind – 17 PSF
  - Live Load – HS20 (live load not carried by truss members)

Recommended Work: Fascia & Portal Siding

- Existing
  - 1” Thick Boards
- Recommended Work
  - Replacement of all Existing Siding Boards (Eastern White Pine) (PTN 2)

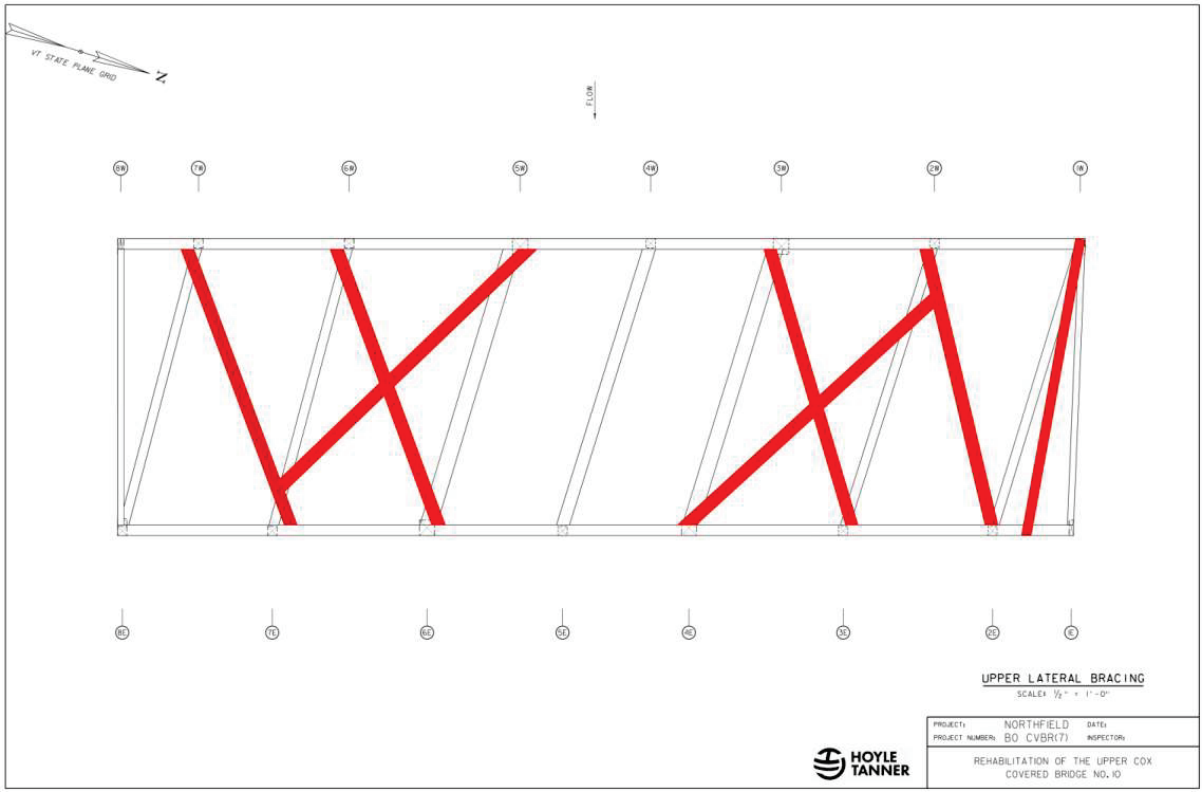
Recommended Work: Roof Members

- Existing
  - Standing Seam Metal Roof
  - 2”x6” Rafters, Eastern Spruce
  - 1” Thick Roof Boards, Eastern Spruce
- Recommended Work
  - New Standing Seam Metal Roof (PTN 2)
  - Replacement all Existing Roof Boards (PTN 2)
  - 8 Rafters (14%) to be Replaced due to Condition (PTN 2)

Recommended Work: Lat. Bracing Members

- Existing
  - 6”x6” Crossbeams, Eastern Spruce
  - 2”x8” Diagonal Braces, Eastern Spruce
  - Steel Knee Braces
- Recommended Work
  - Replacement of all Upper Bracing (PTN 2)
  - 2 Cross Beams (22%) to be Replaced due to Condition (PTN 2)
  - Redo Steel Knee Braces?

Recommended Work: Lat. Bracing Members



Replace all Upper Bracing (PTN 2)

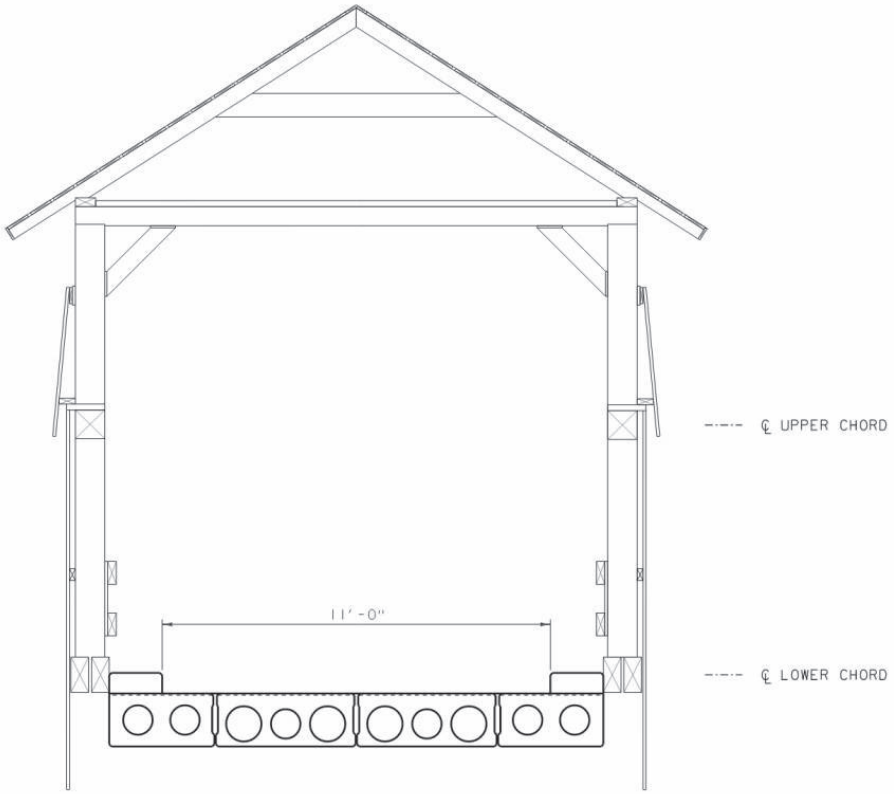
Legend:

Red – Replace due to Strength Needs (PTN 2)

Recommended Work: Floor System

- Existing:
  - 24WF100 and 21WF62 Steel Beams
  - C15x33.9 Steel Diaphragms
  - 2”x6” Nail Laminated Deck, Southern Yellow Pine
  - 1 ½” Thick Runner Boards, Eastern Pine
- Recommended Work
  - Replace Steel Stringers with new Steel Stringers (PTN 2)
  - Replace Deck with Nail Laminated (PTN 2), or Glulam Deck (PTN 4)
  - Replace Runner Boards with Full Width 1 ½” Thick Runners, White Oak (PTN 2)

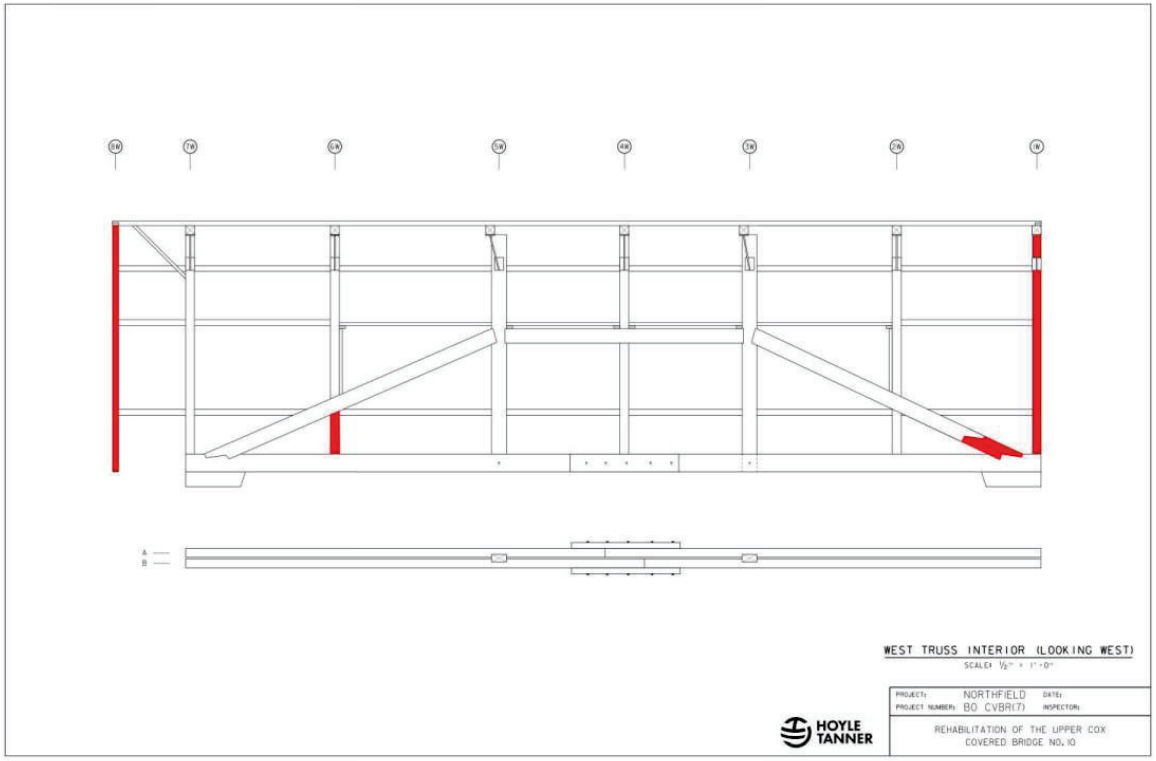
Superstructure Alternative: Deck Beams



Concrete Deck Beams Superstructure Option

- Shallower Superstructure Depth
- Increased Waterway Opening
- Improved Flow

Recommended Work: West Truss



Board Feet of Replacement (PTN 2):

Verticals = 12%

Truss Members = 4%

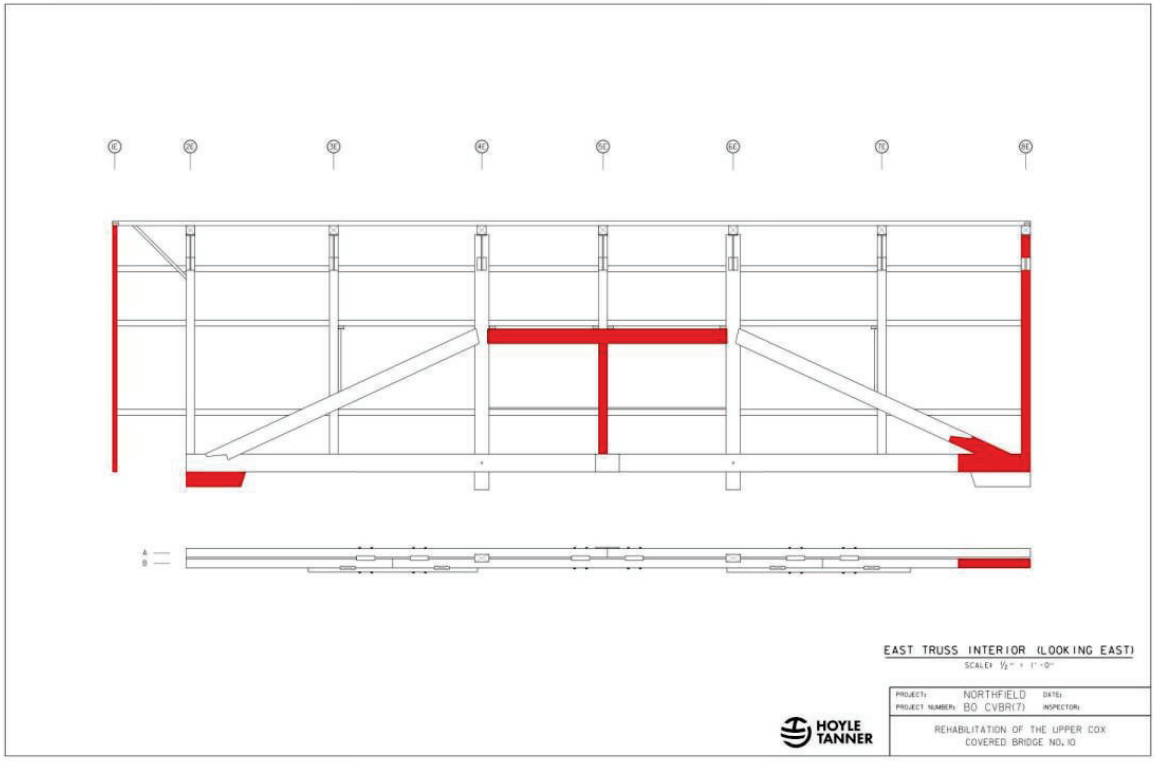
Numerous Repairs (PTN 1)

Assume additional 15% of member replacement and/or repair due to deficiencies in members that were hidden during inspection

Legend:

Red – Replace due to Condition (PTN 2)

Recommended Work: East Truss



Board Feet of Replacement (PTN 2):

Verticals = 22%

Truss Members = 29%

Numerous Repairs (PTN 1)

Assume additional 15% of member replacement and/or repair due to deficiencies in members that were hidden during inspection

Legend:

Red – Replace due to Condition (PTN 2)

Recommended Work: Substructure

- Bridge Seat Elevation Modification (PTN 1)
- Concrete Repair / Crack Sealing (PTN 1)
- Stain And Seal Concrete (PTN 1)

Summary

- Superstructure Replacements/Repairs PTN 1 - 4
- Substructure Repairs PTN 1
- Current Live Load Rating = 10 Tons
- Proposed Live Load Rating = 20 Tons
- Approach Work
  - Approximate 200’ of Roadway Reconstruction
  - New Signage
  - New Steel Backed Timber Guardrail

Questions on Upper Cox Brook Recommended Work?

HOYLE TANNER

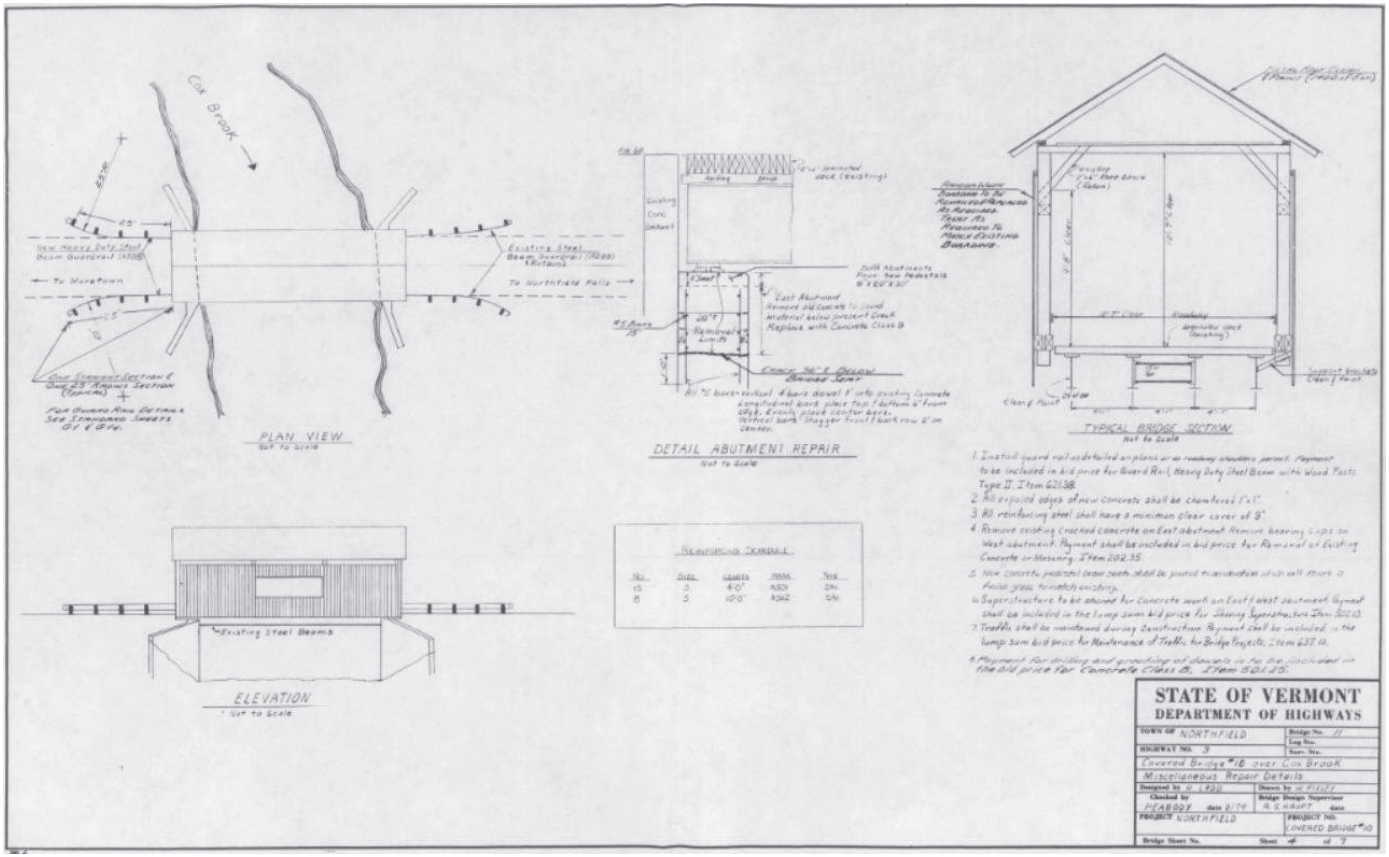
Lower Cox Brook Covered Bridge

HOYLE TANNER

Existing Bridge Information

- Bridge Constructed in 1872, Rehabilitated in 1967 & 1979
- Listed in National Register of Historic Places in 1974
- Queen Post Trusses
  - 57’ Long
  - 15’-4” Horizontal Clearance
  - 12’-0” Vertical Clearance (Posted)
  - Weight Limit (12-Ton, Single Axle, 15-Ton Tandem, 21-Ton Gross)
- Substructures: Concrete Faced Stone Abutments

Section and Elevation View



Inspection Findings

- Overall Bridge Condition = **4 (Poor)**
- Deck Condition = 5 (Fair)
- Superstructure Condition = 4 (Poor)
- Substructure Condition = 5 (Fair)
- Channel Condition = 7 (Good)

Condition Rating	Description
9	Excellent Condition
8	Very Good Condition
7	Good Condition
6	Satisfactory Condition
5	Fair Condition
4	Poor Condition
3	Serious Condition
2	Critical Condition
1	Imminent Failure Condition

Metal Roof

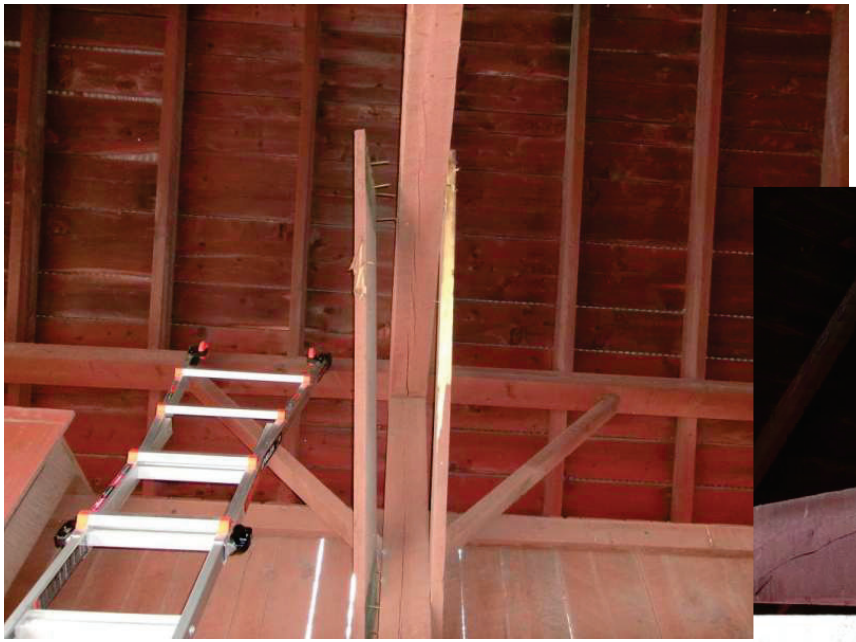
- Rusting
- Leaks
- Nail Attachment

Roofboards, Rafters & Rafter Support Beam

- Splits
- Breaks
- Rot
- Insect Damage

Upper Bracing Members

- Splits
- Breaks
- Rot
- Impact Damage



Truss Members

- Splits
- Breaks
- Rot
- High Moisture Content

Steel Beams

- Rust Holes
- Advanced Corrosion

Approaches

- Drainage Issues
- Ponding

Deck

- Breaks
- Poor Attachment

Abutments

- Voids
- Spalling
- Exposed Rebar
- CMU Truss Bearings

Rehabilitation Alternatives

- Bridge Rehabilitations are feasible based on:
  - Current condition of bridge
  - Deterioration types and levels of section losses observed
  - Expected remaining service life
- Rehabilitation includes:
  - Repair, strengthening, or replacement of bridge members
- Bridge Loads
  - Snow – 60 PSF Ground, 31 PSF Roof Applied
  - Wind – 17 PSF
  - Live Load – HS20 (live load not carried by truss members)

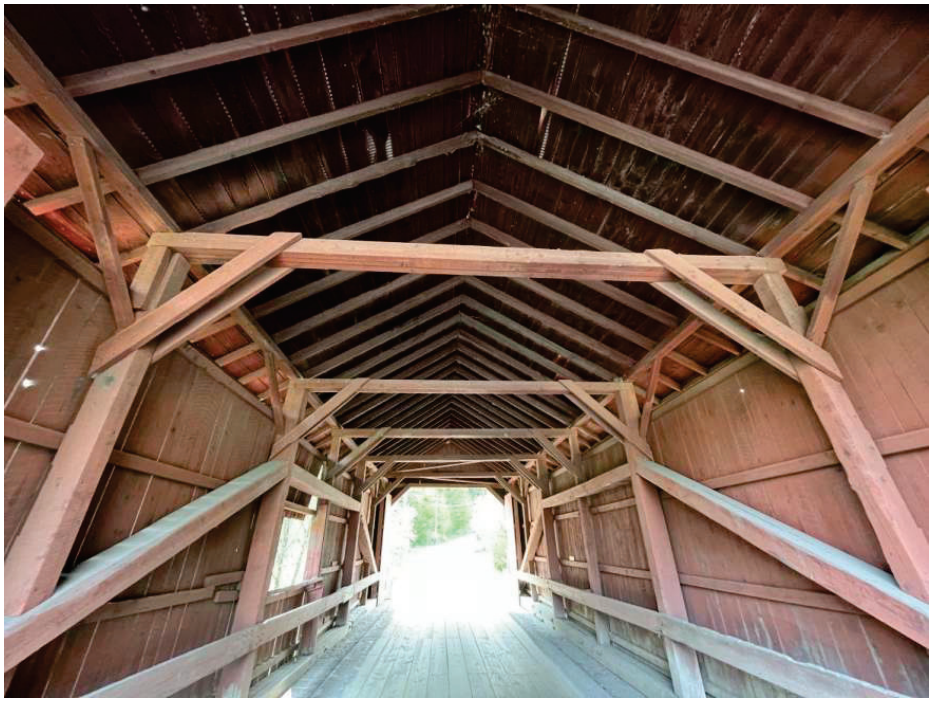
Recommended Work: Fascia & Portal Siding

- Existing
  - 1” Thick Boards
- Recommended Work
  - Replacement of all Existing Siding Boards (Eastern White Pine) (PTN 2)

Recommended Work: Roof Members

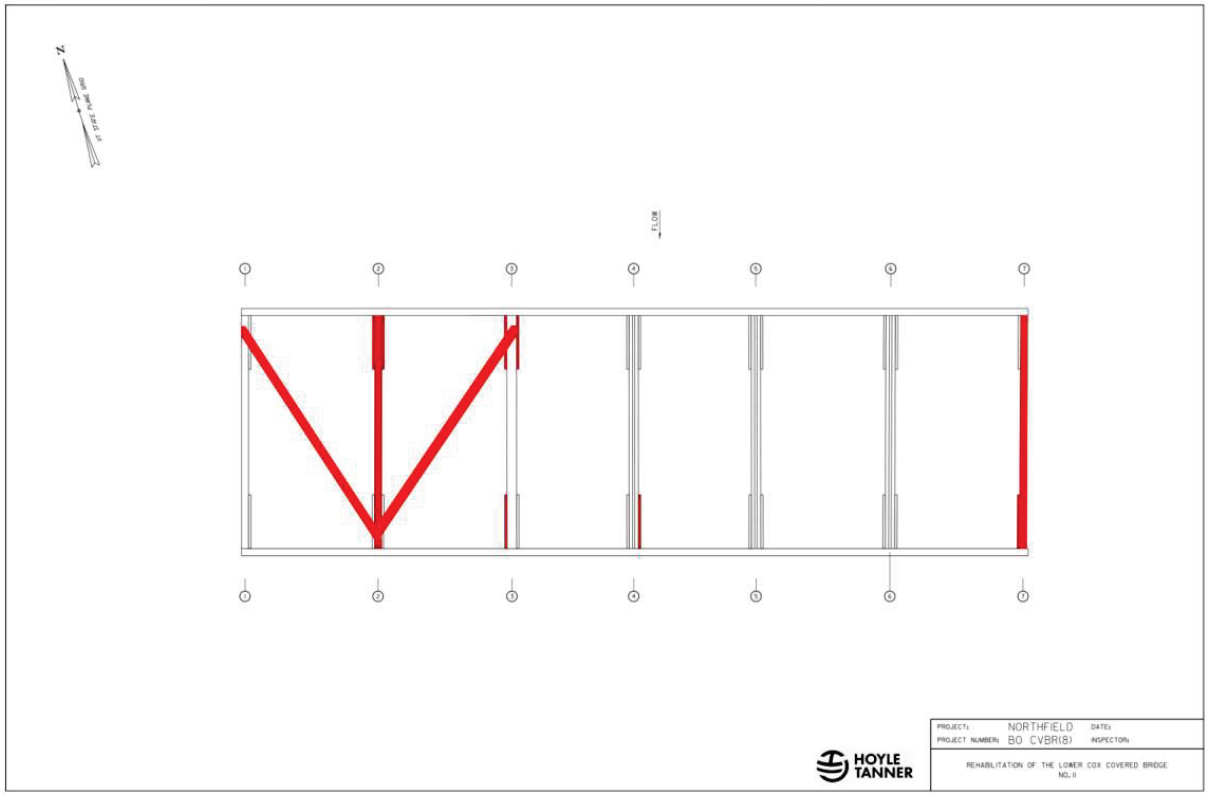
- Existing
  - Standing Seam Metal Roof
  - 2”x6” Rafters, Eastern Spruce
  - 1”x8” Roof Boards, Eastern Spruce
  - 6”x6” Rafter Support Beam, Eastern Spruce
- Recommended Work
  - New Standing Seam Metal Roof (PTN 2)
  - Replacement all Existing Roof Boards (PTN 2)
  - 5 Rafters (8%) to be Replaced due to Condition (PTN 2)
  - 1 Rafter Support Beam (8%) to be Replaced due to Condition (PTN 2)

Recommended Work: Lat. Bracing Members



- Existing
  - 6”x6” Crossbeams, Eastern Spruce
  - 2”x8” Diagonal Braces, Eastern Spruce (North Portal Only)
  - 2”x6” Knee Braces, Hemlock

Recommended Work: Lat. Bracing Members



- Replacement of all Upper Bracing (PTN 2)
- 2 Crossbeams (29%) to be Replaced due to Condition (PTN 2)
- 7 Knee Braces (29%) to be Replaced due to Condition (PTN 2)
- Strengthen all Knee Braces (PTN 3)

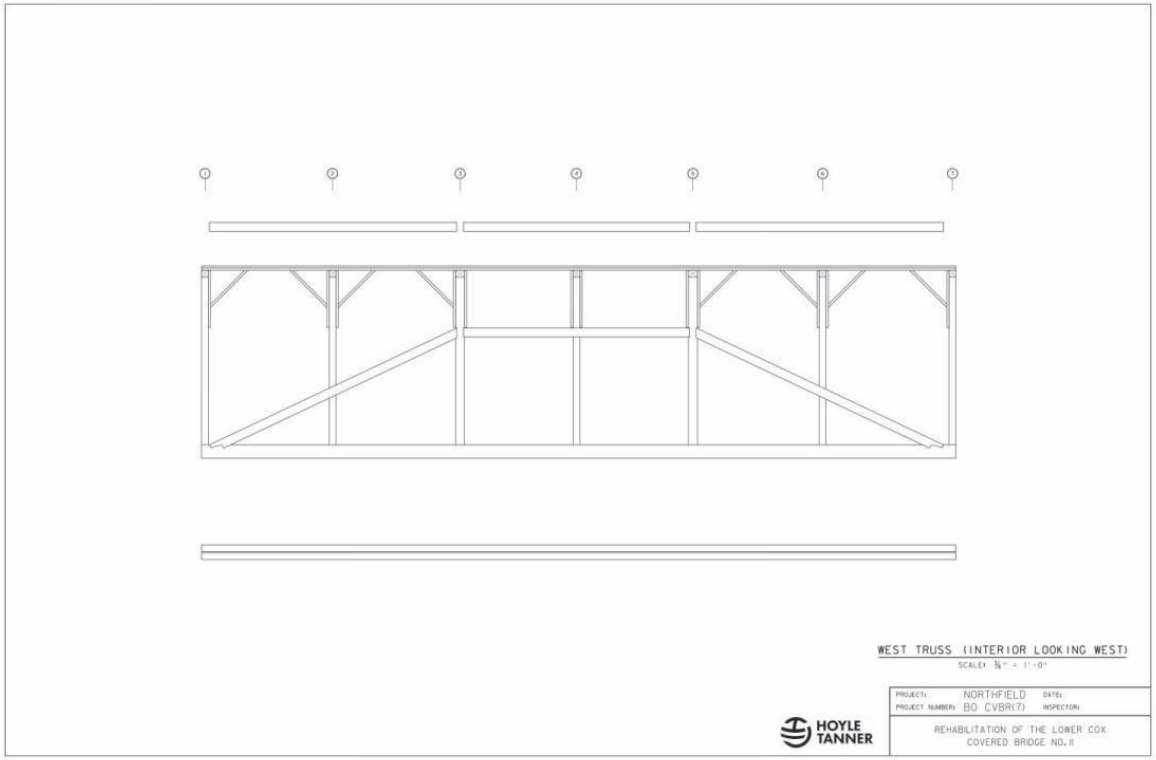
Legend:

Red – Replace due to Condition (PTN 2)

Recommended Work: Floor System

- Existing:
  - 24WF84 Steel Beams
  - C15x33.9 Steel Diaphragms
  - 2”x6” Nail Laminated Deck, Southern Yellow Pine
  - 1 ⅝” Thick Runner Boards, Eastern Spruce
- Recommended Work
  - Replace Steel Stringers with new Steel Stringers (PTN 2)
  - Replace Deck with Nail Laminated (PTN 2), or Glulam Deck (PTN 4)
  - Replace Runner Boards with Full Width 1 ½” Thick Runners, White Oak (PTN 2)

Recommended Work: North Truss



No Truss Member Replacements

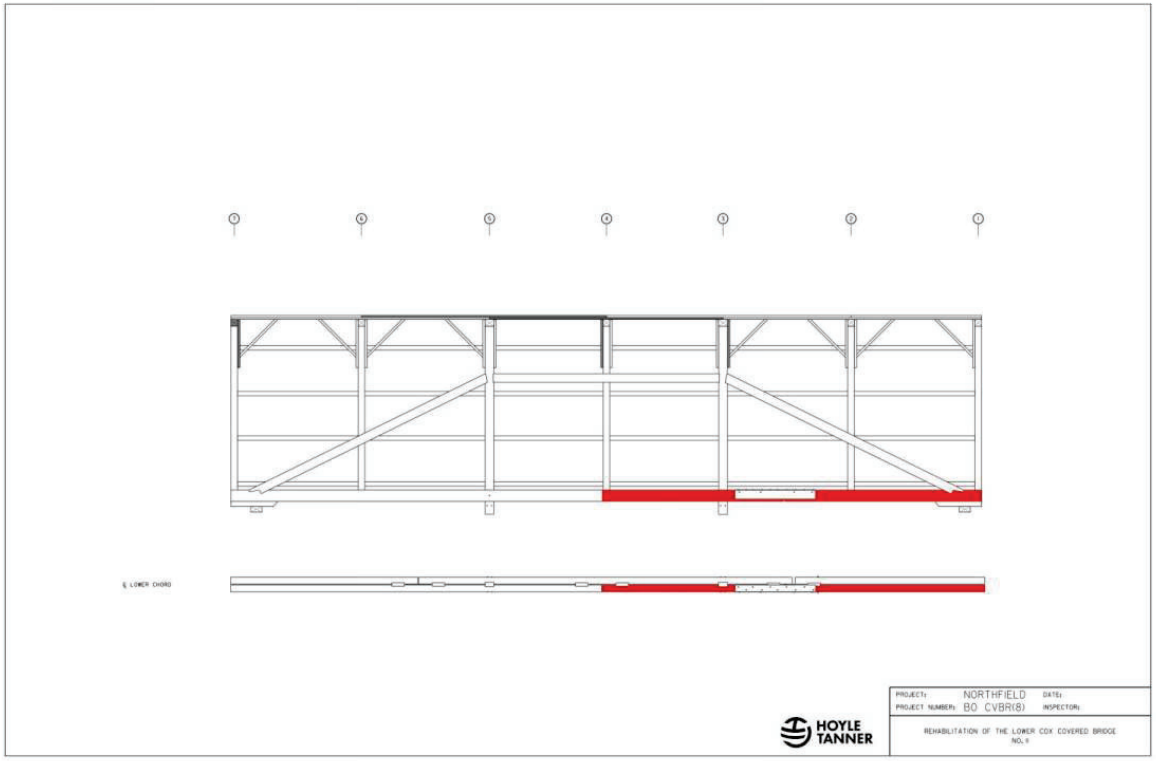
Numerous Repairs (PTN 1)

Assume additional 15% of member replacement and/or repair due to deficiencies in members that were hidden during inspection

Legend:

Red – Replace due to Condition (PTN 2)

Recommended Work: South Truss



Board Feet of Replacement (PTN 2):

Truss Members = 16%

Numerous Repairs (PTN 1)

Assume additional 15% of member replacement and/or repair due to deficiencies in members that were hidden during inspection

Legend:

Red – Replace due to Condition (PTN 2)

Recommended Work : Truss Bearings

- Replace Bearing Blocks at all 4 Truss Bearing Locations (PTN 2)

Recommended Work: Substructure

- Replace East Abutment (PTN 2)
  - Alternative 1 – Stone Masonry
  - Alternative 2 – Reinforced Concrete

Recommended Work: Substructure

- Repair West Abutment
  - Backwall Replacement (PTN 2)
  - Bridge Seat Elevation Modification (PTN 1)
  - Concrete Repair / Crack Sealing (PTN 1)
  - Stain and Seal Concrete (PTN 1)

Summary

- Superstructure Replacements/Repairs PTN 1-4
- Substructure Replacement and Repairs PTN 1-2
- Current Live Load Rating = 12 Tons
- Proposed Live Load Rating = 20 Tons
- Approach Work
  - Approximate 300’ of Roadway Reconstruction to Improve Drainage
  - New Signage
  - New Steel Backed Timber Guardrail

Questions on Lower Cox Brook Recommended Work?

HOYLE TANNER

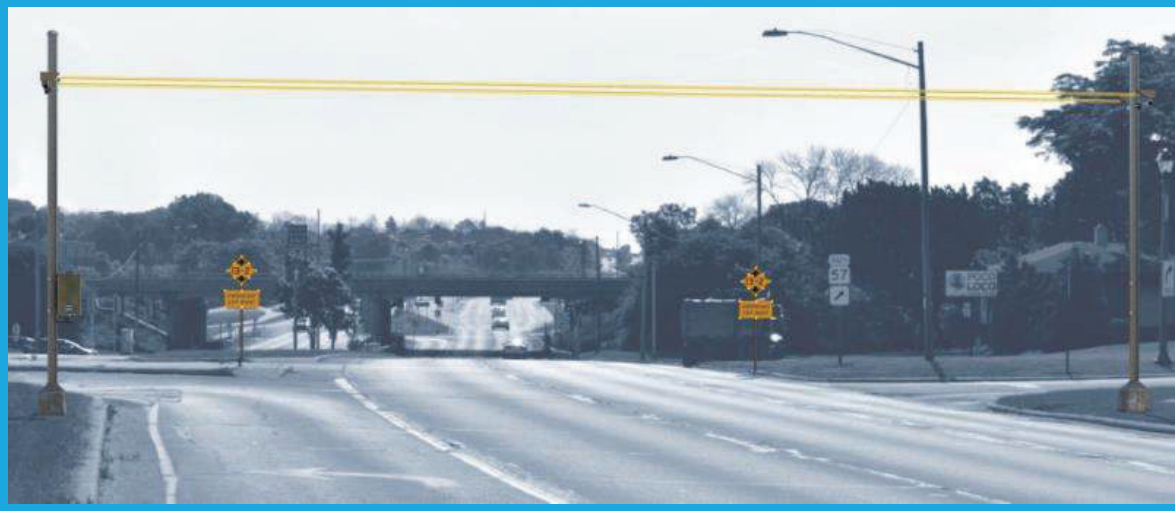
Vertical Clearance Improvements

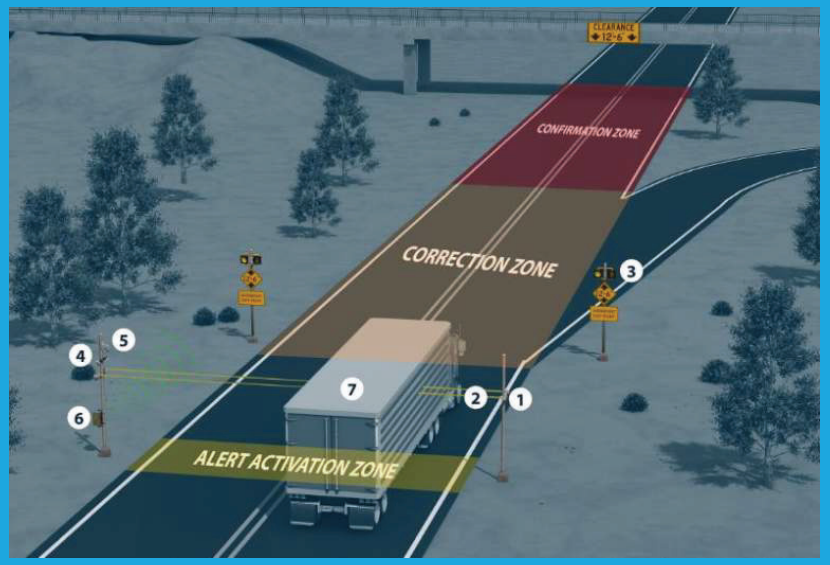
HOYLE TANNER

Oversized Vehicles

Early Detection and Warning System

- Detects vehicles that won't clear structure ahead
- Notifies drivers of height restrictions
- Directs drivers towards safe, alternate route
- Collects data for vehicles that trigger system
- Notifies local authorities when vehicles enter confirmation zone

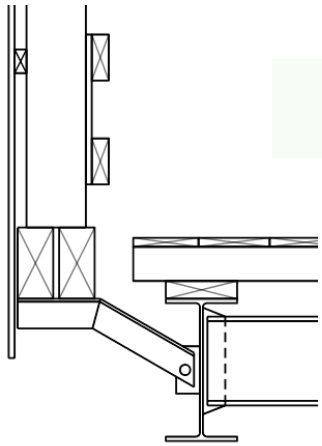




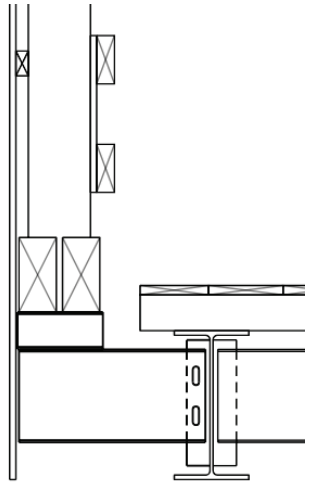
HOYLE TANNER

Modifications to Increase Clearance

- Existing trusses are laterally braced against the steel beams using steel plates and slotted holes, allowing vertical movement but not transverse movement
- Maintain similar detail as existing, laterally bracing trusses against steel beams
- Use steel channel or w-beam section supported on lateral bracing member to raise up bottom chord, increasing vertical clearance
- Increase all 3 bridges to provide same vertical clearance

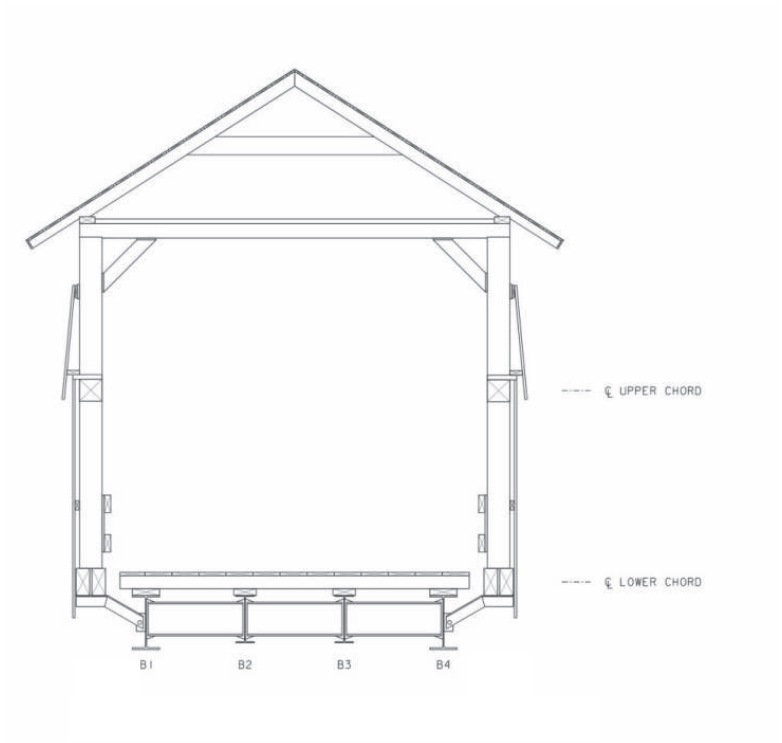


Existing Detail

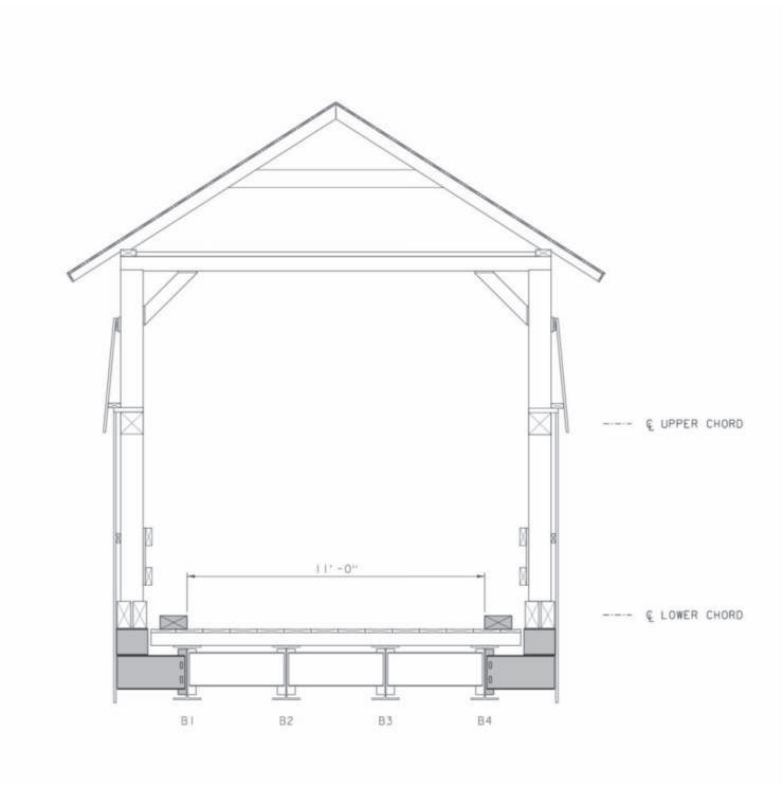


Proposed Detail

Upper Cox Bridge Vertical Clearance Modifications

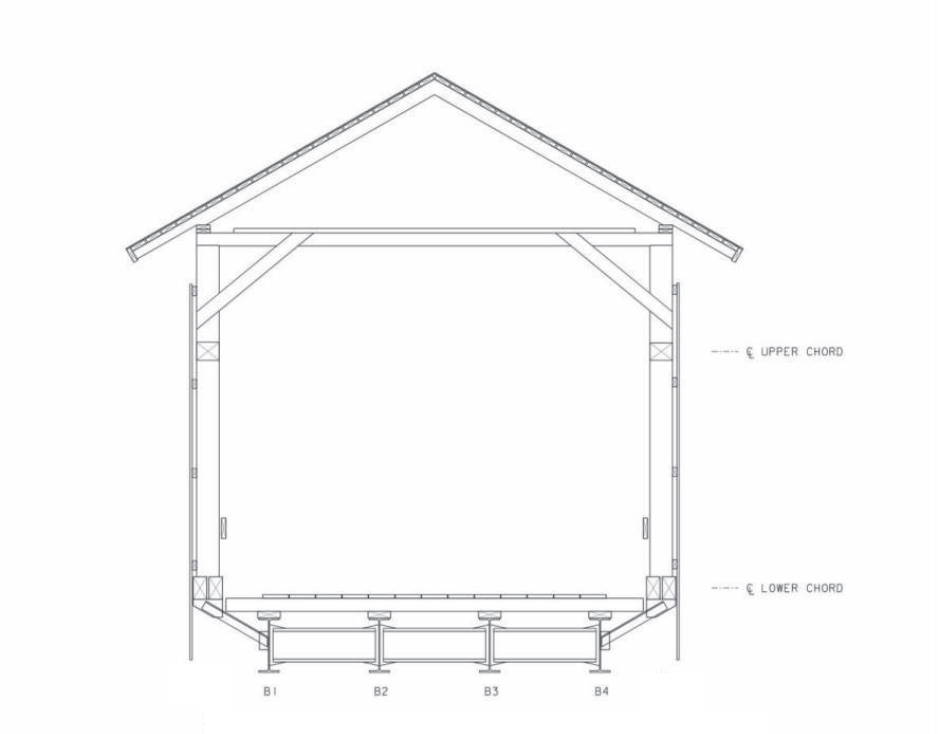


Existing Vertical Clearance
12’-4”

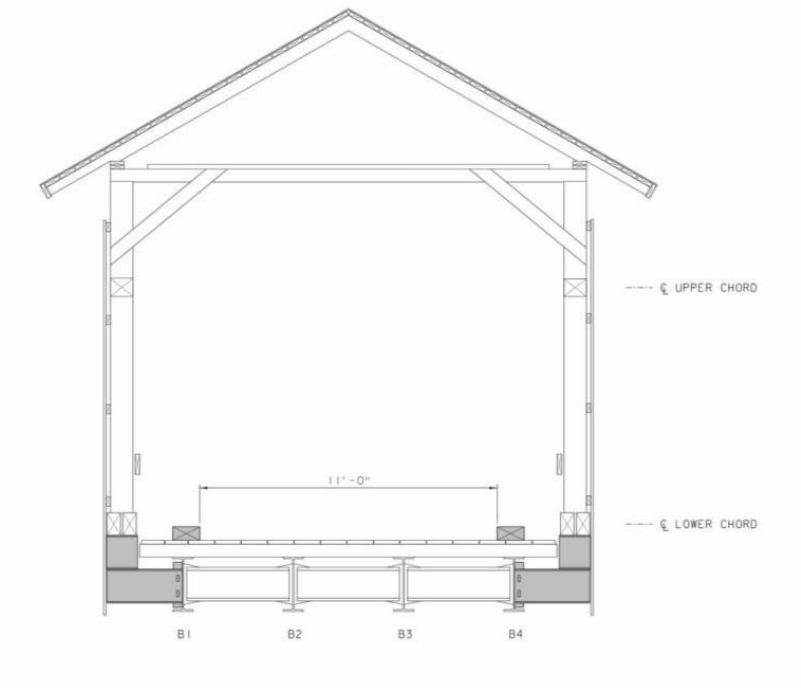


Proposed Vertical Clearance
13’-3”

Lower Cox Bridge Vertical Clearance Modifications

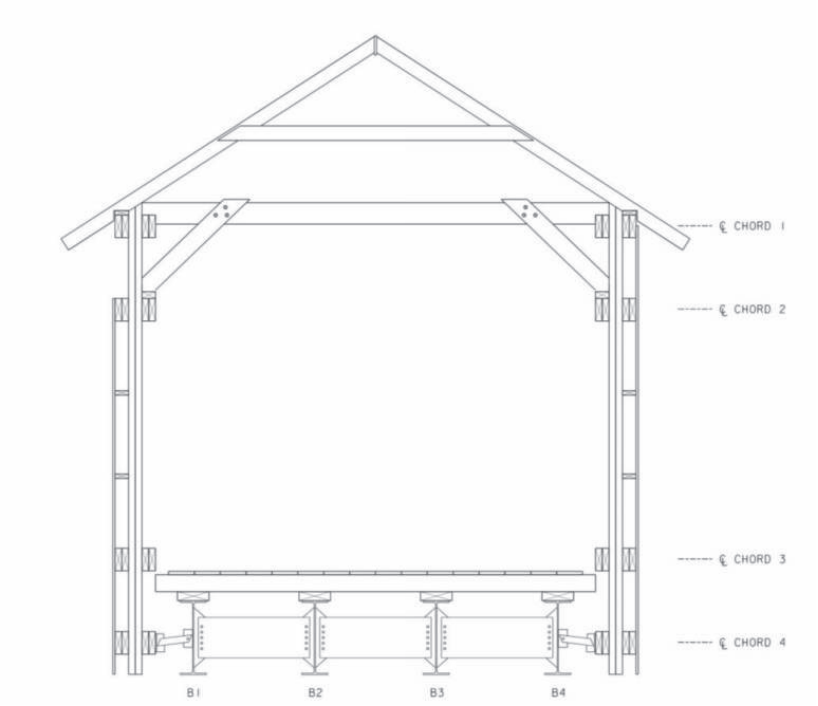


Existing Vertical Clearance
12’-10”

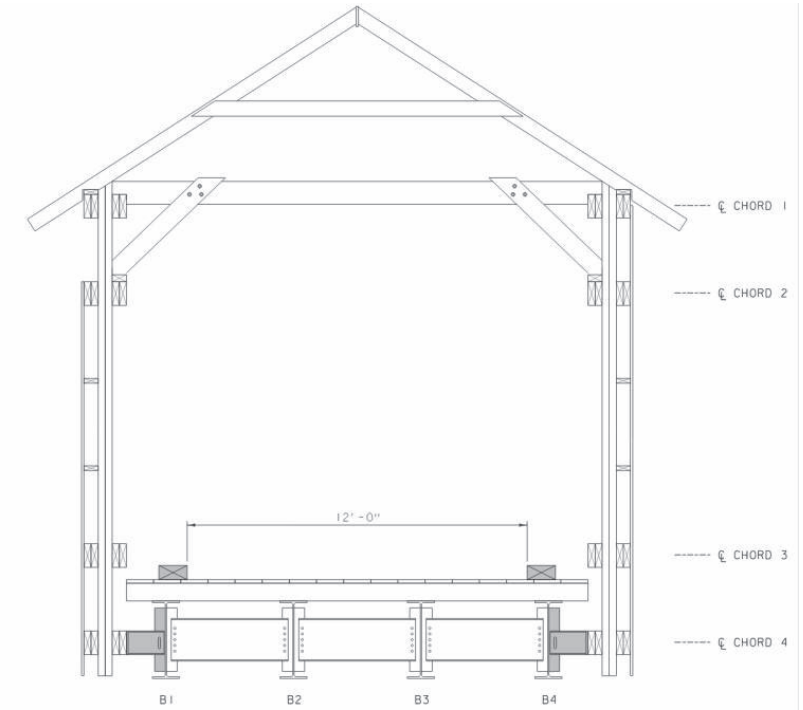


Proposed Vertical Clearance
13’-3”

Falls Bridge Vertical Clearance Modifications



Existing Vertical Clearance
12’-9”



Proposed Vertical Clearance
13’-3”

HCBPC Alternative Meeting

Upper Cox Brook Covered Bridge
Northfield BO CVBR(7)
TH #3, Bridge No. 10 over Cox Brook

Lower Cox Brook Covered Bridge
Northfield BO CVBR(8)
TH #3, Bridge No. 11 over Cox Brook

Northfield Falls Covered Bridge
Northfield BO CVBR(9)
TH #3, Bridge No. 15 over Dog River

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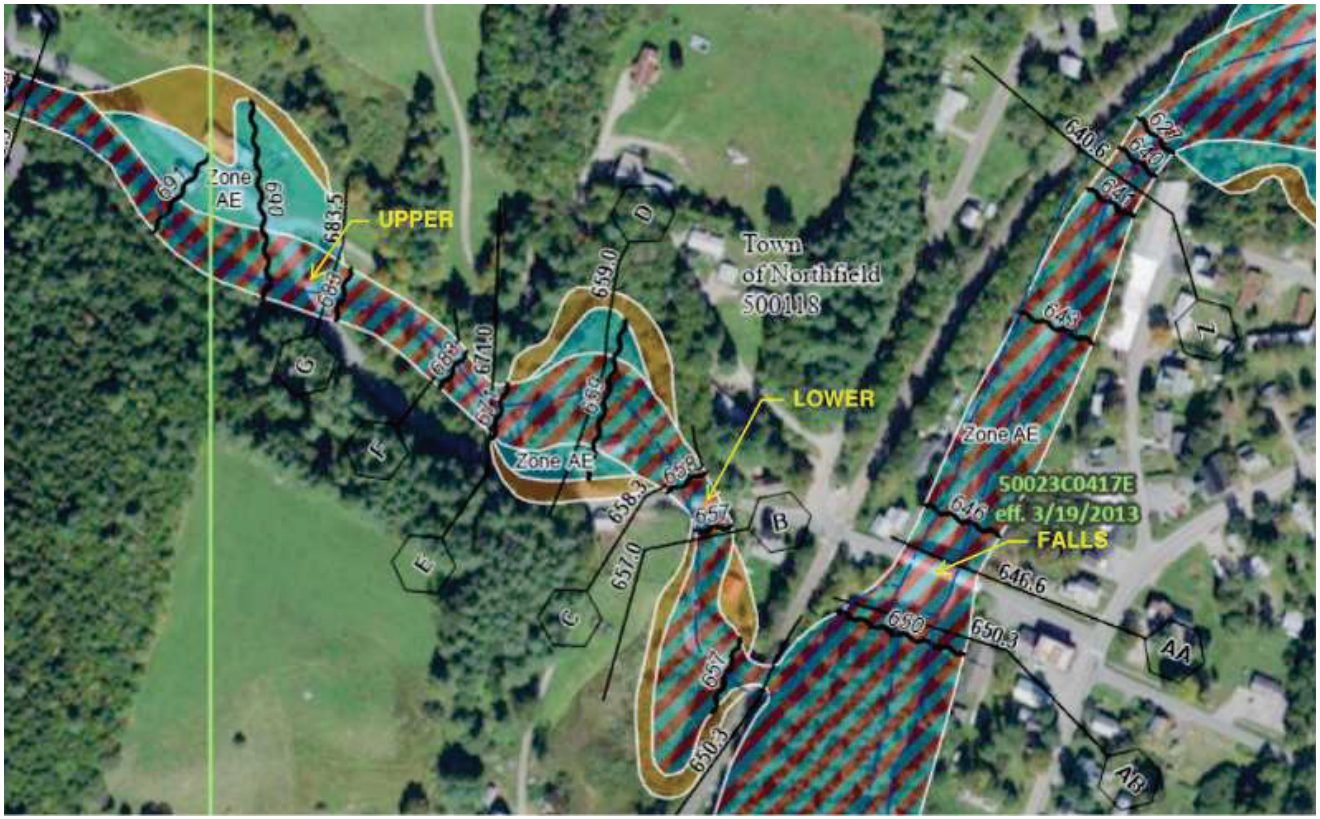
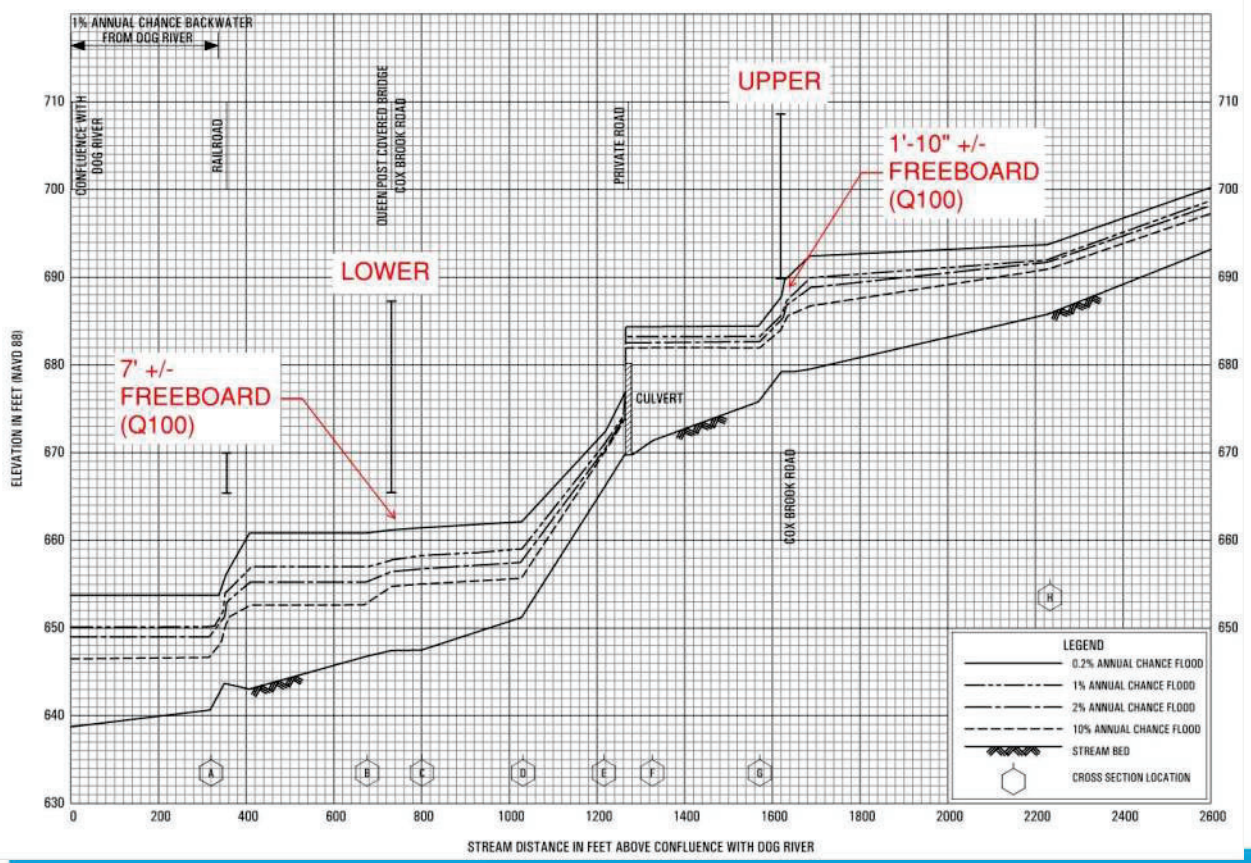
VTrans Working to Get You There
Vermont Agency of Transportation

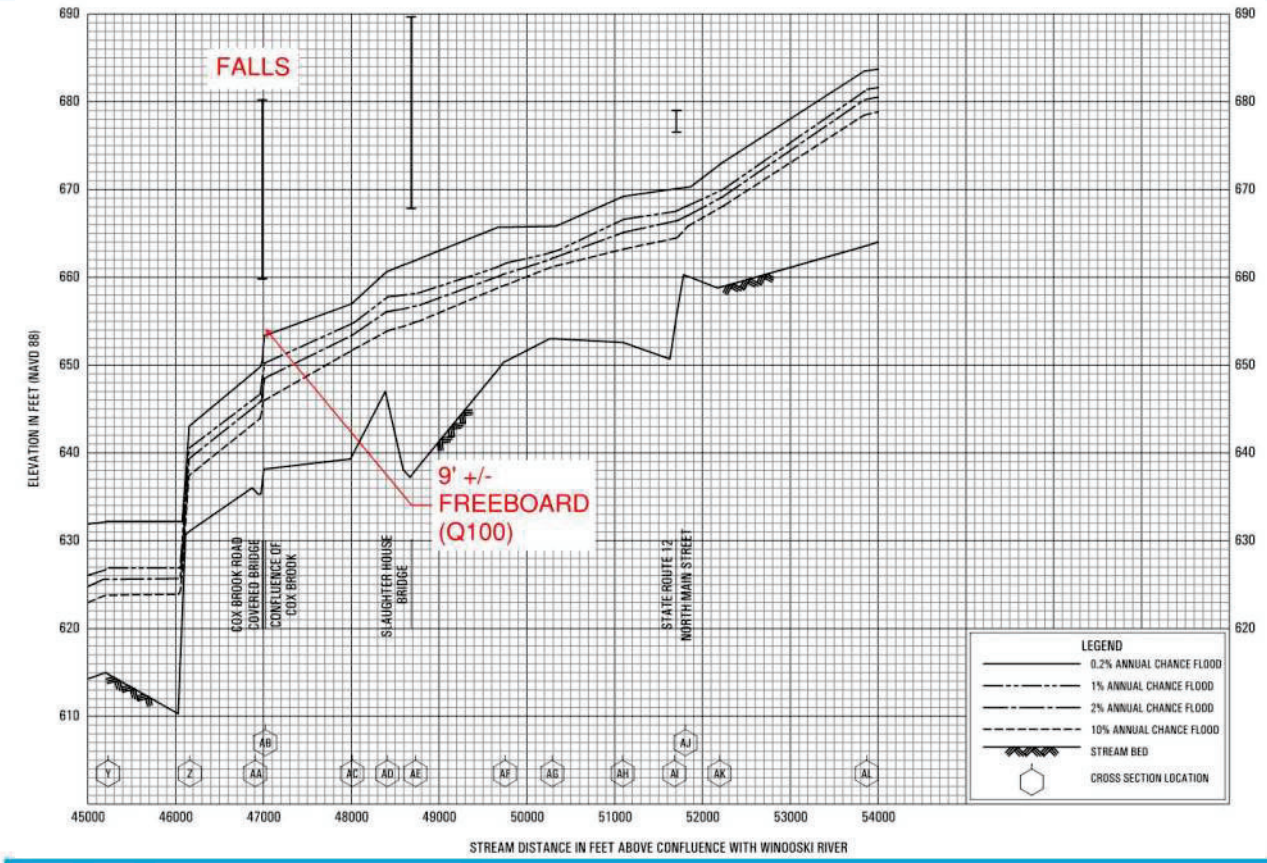
FEMA Flood Maps



FEMA Cross Sections – Cox Brook



FEMA Cross Sections – Dog River



Superstructure Alternatives

- Upper Cox Brook Covered Bridge

	Superstructure Type			
	Existing	Steel	Concrete	Glulam
Depth	24"	21"	18"	30.25"

Superstructure Alternatives

- Lower Cox Brook Covered Bridge

	Superstructure Type		
	Existing	Steel	Glulam
Depth	24"	24"	37.125”

Superstructure Alternatives

- Northfield Falls Covered Bridge

	Superstructure Type		
	Existing	Steel	Glulam
Depth	33"	33"	42.625”

- Nearby Railroad
- Reinforced Concrete Pier Cap

Northfield Falls Covered Bridge

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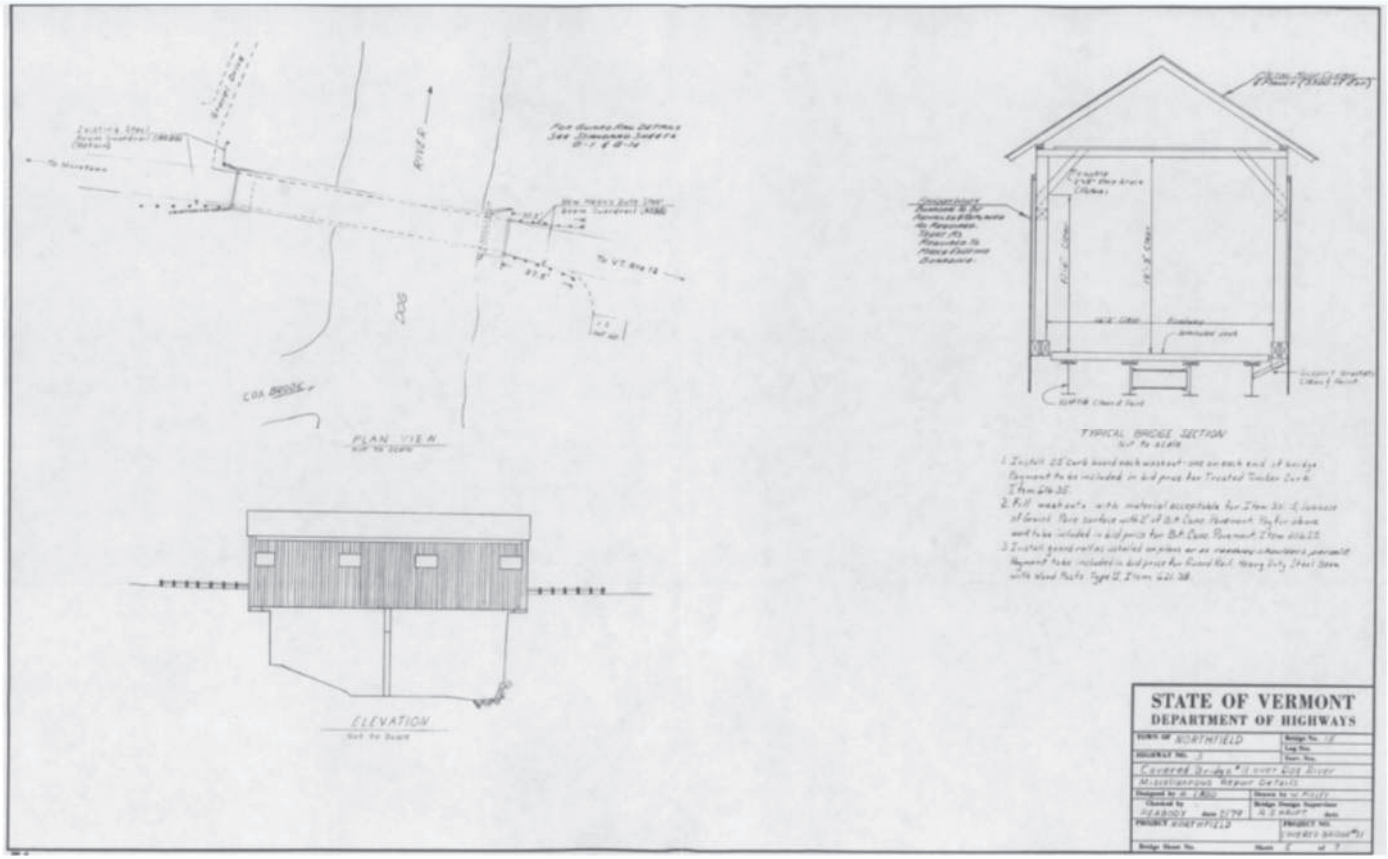
Existing Bridge Information

- Bridge Constructed in 1872, Rehabilitated in 1942, 1968 & 1979
- Listed in National Register of Historic Places in 1974
- Town Lattice Trusses
  - 137’ Long
  - 16’-0” Horizontal Clearance
  - 12’-0” Vertical Clearance (Posted)
  - Posted Weight Limit 10-Ton
- Substructures: Reinforced Concrete Pier, Stone and Concrete Abutments

Section and Elevation View



1937 Portal View

Inspection Findings

- Overall Bridge Condition = **4 (Poor)**
- Deck Condition = 5 (Fair)
- Superstructure Condition = 5 (Fair)
- Substructure Condition = 4 (Poor)
- Channel Condition = 8 (Very Good)

Condition Rating	Description
9	Excellent Condition
8	Very Good Condition
7	Good Condition
6	Satisfactory Condition
5	Fair Condition
4	Poor Condition
3	Serious Condition
2	Critical Condition
1	Imminent Failure Condition

Roofboards & Rafters

- Splits
- Breaks
- Rot
- Insect Damage

Upper Bracing Members

- Splits
- Breaks
- Rot
- Impact Damage

Truss Members

- Splits
- Breaks
- Rot
- Misalignment
- High Moisture Content

Steel Beams

- Rusting
- Advanced Corrosion

Approaches

- Drainage Issues
- Ponding

Substructure

- Voids
- Spalling
- Exposed Rebar

Rehabilitation Alternatives

- Bridge Rehabilitation is feasible based on:
  - Current condition of bridge
  - Deterioration types and levels of section losses observed
  - Expected remaining service life
- Rehabilitation includes:
  - Repair, strengthening, or replacement of bridge members
- Bridge Loads
  - Snow – 60 PSF Ground, 31 PSF Roof Applied
  - Wind – 19 PSF
  - Live Load – HS20 (live load not carried by truss members)

Recommended Work: Fascia & Portal Siding

- Existing
  - 1” Thick Boards
- Recommended Work
  - Replacement of all Existing Siding Boards (Eastern White Pine) (PTN 2)

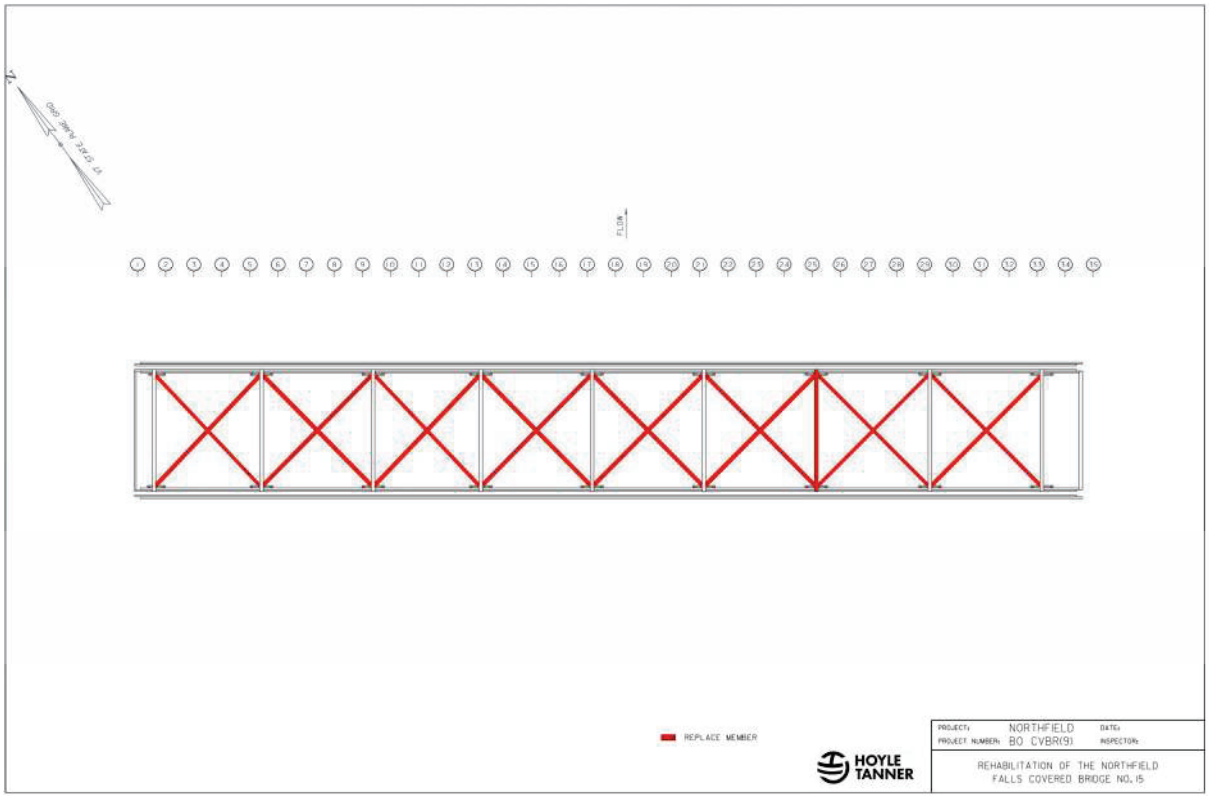
Recommended Work: Roof Members

- Existing
  - Standing Seam Metal Roof
  - 2”x6” Rafters, Eastern Spruce
  - 1”x8” Roof Boards, Eastern Spruce
- Recommended Work
  - New Standing Seam Metal Roof (PTN 2)
  - Replacement of Roof Boards (25%) (PTN 2)
  - 14 Rafters (20%) to be Replaced due to Condition (PTN 2)

Recommended Work: Lat. Bracing Members

- Existing
  - 6”x6” Upper Diagonal Braces, Eastern Spruce
  - 2”x8” Knee Braces, Eastern Spruce

Recommended Work: Lat. Bracing Members



- 1 Crossbeam (11%) to be Replaced due to Condition (PTN 2)
- All Braces to be Replaced due to Condition (PTN 2)

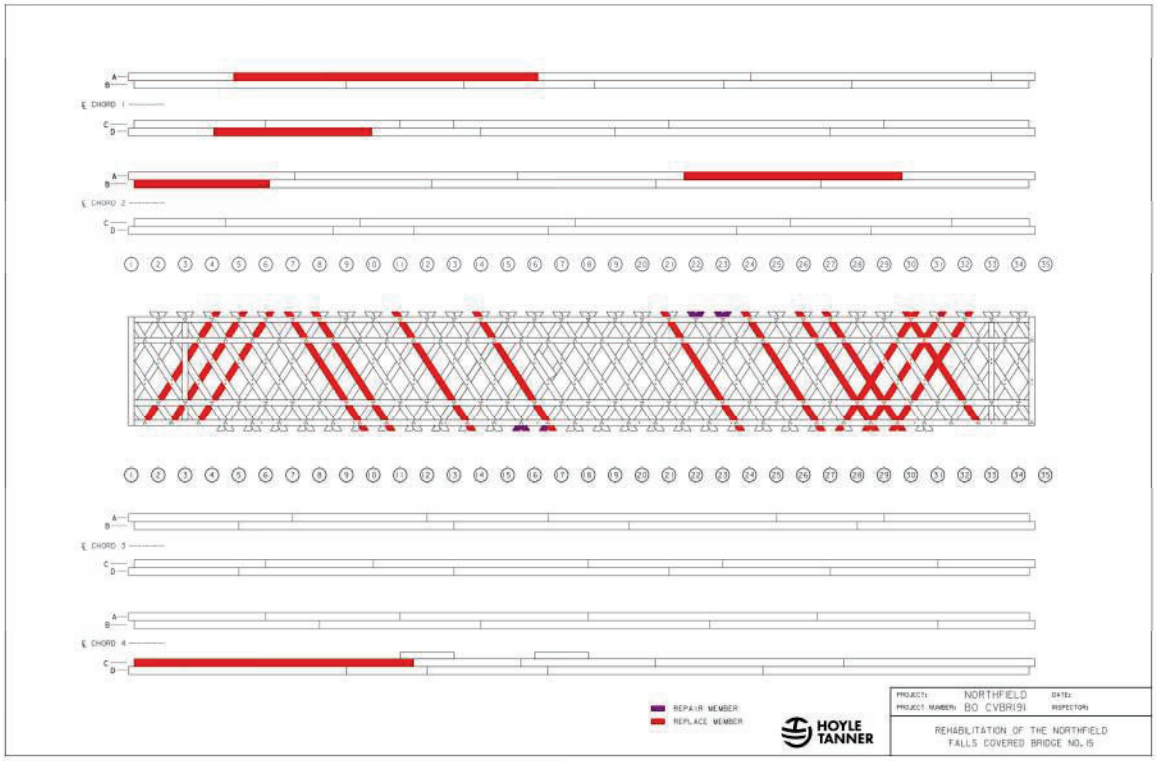
Legend:

Red – Replace due to Condition (PTN 2)

Recommended Work: Floor System

- Existing:
  - 33WF118 Steel Beams
  - C18x42.7 Steel Diaphragms
  - 2”x8” Nail Laminated Deck, Southern Yellow Pine
  - 1½” Thick Runner Boards, Eastern Hemlock
- Recommended Work
  - Replace Steel Stringers with new Steel Stringers (PTN 2)
  - Replace Deck with Nail Laminated (PTN 2), or Glulam Deck (PTN 2)
  - Replace Runner Boards with Full Width 1 ½” Thick Runners, White Oak (PTN 2)

Recommended Work: North Truss



Board Feet of Replacement (PTN 2):

Lattices = 22%

Chord Members = 8%

Numerous Repairs (PTN 1)

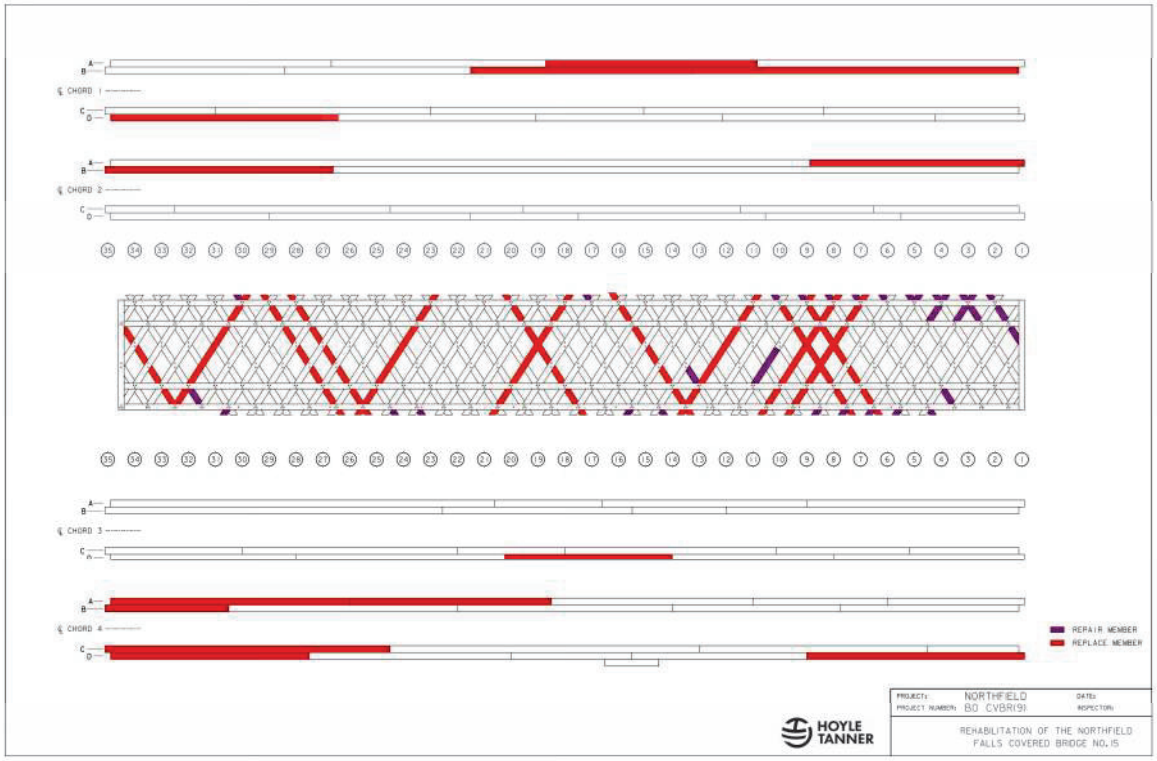
Assume additional 15% of member replacement and/or repair due to deficiencies in members that were hidden during inspection

Legend:

Red – Replace due to Condition (PTN 2)

Purple – Repaired due to Condition (PTN 1)

Recommended Work: South Truss



Board Feet of Replacement (PTN 2):

Lattices = 19%

Chord Members = 20%

Numerous Repairs (PTN 1)

Assume additional 15% of member replacement and/or repair due to deficiencies in members that were hidden during inspection

Legend:

Red – Replace due to Condition (PTN 2)

Purple – Repaired due to Condition (PTN 1)

Recommended Work: Truss Bearings

- Replace Bearing Blocks at all 6 Truss Bearing Locations (PTN 2)

Recommended Work: Substructure

- West Abutment
  - Repair West Abutment (PTN 1)
  - Replace Concrete Cap (PTN 2

Recommended Work: Substructure

- Pier
  - Adjust Beam Seat Elevations for Steel Stringers (PTN 1)
  - Concrete Repair / Crack Sealing (PTN 1)
  - Stain And Seal Concrete (PTN 1)

Recommended Work: Substructure

- Replace East Abutment (PTN 2)
  - Alternative 1 – Stone Masonry
  - Alternative 2 – Reinforced Concrete

Summary

- Superstructure Replacements/Repairs PTN 1 - 4
- Substructure Repairs and Replacement PTN 1-2
- Current Live Load Rating = 20 Tons
- Proposed Live Load Rating = 20 Tons
- Approach Work
  - Approximate 300’ of Roadway Reconstruction to Improve Drainage
  - New Signage
  - New Steel Backed Timber Guardrail

Questions on Northfield Falls Recommended Work?

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Right-of-Way, Utilities, Fire Protection

- Right of Way is 3-Rod
- Relocation of Utilities may be Required
- Insecticide/Fungicide
- Fire Protection
  - Recommend NOCHAR
  - Protectowire/Sprinkler
- Lighting

Anticipated Schedule

Northfield Upper Cox, Lower Cox, and Falls Covered Bridges
HCBPC Alternative Meeting Notes
VTrans Project No's Northfield BO CVBR(7), (8), & (9)
September 4th and 12th, 2024

Attendees:

Emily Baker, Eric Gilberston, Robert McCullough, Greg Socinski, Jeff Schulz, Laura Stone, Carolyn Cota, Judith Ehrlich, Jim Lacroix, Andrew Lemieux, JB McCarthy, Kyle Obenauer, Gary Sweeny, John Weaver, Laura Trieschmann, Josif Bicja, Sean James, Todd Sumner, Kelly LaVigne

Meeting Minutes:

1. Upper Cox Bridge (Bridge 10) Discussion & Questions from Meeting Attendees
    a. Was there any flood damage during recent major storm events?
        i. None was noted during HTA's inspections, and no damage was noted since the inspections were complete.
        ii. There is some evidence of high water at the bridge site.
        iii. John Weaver noted this bridge has had hydraulic issues in the past.
        iv. The hydraulic study has not been completed yet.
    b. Are abutments founded on bedrock?
        i. Yes, they are founded on bedrock so there is no scour concern.
    c. Has there been any consideration of using glulam beams instead of steel?
        i. No, HTA did not consider glulam beams instead of steel. Oil based treatments used previously for glulam beams have been banned in recent years. Water-based treatments are not as good, leading to increased deterioration over time.
        ii. The existing steel beams are painted. HTA would recommend galvanizing or metalizing the beams to prevent deterioration.
        iii. Glulam beams would need to be deeper sections than the proposed steel beams, which would further restrict an already undersized hydraulic opening at the Upper Cox Bridge. There is some limited ability to raise the roadway grade to offset this increased section depth.
        iv. HTA will determine depth needed for glulam beam but will need final hydraulics to confirm that this option is viable.
    d. Committee agrees with replacement of steel knee braces with timber knee braces.
    e. Will rough cut timber be used?
        i. HTA has specified rough cut timber glulam beams in the past and there was no issue with procurement of material for construction.
    f. Is there any racking of the bridge?
        i. Yes, there is racking due to impact damage. Multiple cross beams have shifted from impact damage, causing knee braces to twist. Knee braces will be strengthened to prevent twisting in the event of impact.
    g. What percent of bridge is original? What percent will be original after this project?
        i. Based on HTA field inspections, the trusses are mostly original. Upper bracing, verticals at the portals, and rafters all appear to be replacements. HTA has not calculated percent original vs percent replacement since the bridge was first built but has calculated percent replacement based on what is current in place.
    h. For the concrete deck beams option, would a wood deck be placed over the concrete? Would the concrete be visible on the exterior of the bridge?
        i. The siding would cover the concrete deck at the exterior.

ii. HTA would need to brainstorm ways to connect a timber deck over the concrete. There isn't an easy way to do this, which is why steel beams were proposed.
iii. Committee feels that the timber deck is important user experience of the covered bridge. Could concrete beams be used instead of steel?
1. Concrete beams would be deeper than steel beams and are not preferred at this location due to hydraulic clearance concerns.
iv. Sleepers and nail runner boards could be used to connect the timber deck.
v. Regardless of attachment method of timber deck, the timber sitting on concrete would be damp, causing durability and maintenance issues.

i. If steel or glulam beams are used, committee will need to decide on glulam or nail laminated decking
i. VTrans prefers glulam deck for visual and durability purposes.
ii. No objections from committee members for glulam deck. All agree with this preferred alternative.

j. Do steel knee braces cause more damage to verticals since they are stiffer?
i. With steel knee braces, the lag screws can split/damage the timber member
ii. With wood knee braces, the brace would be designed to break before the lag screw or verticals. Likely will double up knee braces (one on each side of vertical)
iii. John Weaver suggested shiplap joints to help with this.

2. Lower Cox Bridge (Bridge 11) Discussion & Questions from Meeting Attendees
a. What is being proposed to improve drainage at the bridge end?
i. Stop drains can be used. Can potentially lower the grade at one end so it slopes away from the bridge.
b. Should glulam beams be considered at Lower Cox Bridge?
i. Superstructure alternatives being considered for the Upper Cox Bridge will also be considered for Lower Cox Bridge.
c. Is this bridge getting hit any less than Upper Cox Bridge?
i. It is getting struct regularly by oversized vehicles.
d. What will be done with knee braces?
i. Knee braces will be strengthened. Currently, they are secured using nails, but HTA would recommend using lag bolts.
e. What is suggested to be done with the abutments?
i. Two alternatives are proposed – laid stone or concrete abutment.
ii. Laid stone would likely require ledge removal due to high bedrock. Bedrock removal would be minimized by using a concrete abutment.
iii. VTrans prefers replacing it with a concrete abutment. No objections from the Committee.

3. Northfield Falls Bridge (Bridge 15) Discussion & Questions from Meeting Attendees:
a. Can the curvature of the original portals be replicated? Could the arch be raised or the vertical clearance be increased to accommodate the curvature?
i. Would be difficult to replicate and maintain a minimum of 13' at the edge of travel lanes. We would not want to expose the cross beam.
b. Could we incorporate the trim detail on the portals from the original bridge?
i. Yes, that can be incorporated in the Contract Plans.
c. Are the beams continuous or simple span?

   i. They are simple span but HTA would like to make them continuous to remove a bearing at the pier.
- d. What protection will be used for the steel beams?
   i. Hot dipped galvanized or metalized can be used. Galvanized is HTA's recommendation.
- e. Will the sag be removed from the bridge?
   i. Yes, HTA would like to remove the sag from the bridge. With the number of replacement members, it is likely that positive camber can be introduced back into the bridge.
   ii. Care will be taken during jacking, so no additional damage is caused.
- f. When the center pier was introduced, the continuous span was converted to simple span. What are the stress changes when you change from simple back to continuous?
   i. Right at middle there will be some load reversals so tension areas will be in compression.
- g. Are there scour concerns at this bridge?
   i. Bedrock is not visible, but the channel is not directly against the abutments so there is no scour issues at this location.
- h. Stone vs Concrete Abutment
   i. Committee agrees to concrete abutment as preferred replacement alternative.
   ii. The same form liner will be used at all three bridges.
   iii. Treatment to prevent graffiti can be used.

4. Vertical Clearance Discussion
   - a. Early Warning Detection System
      i. Is this being used anywhere else?
         1. Not in Vermont, but one is out to bid for a project located in Maine
      ii. Are there simplified options compared to what is being shown here?
         1. Yes, the system is customizable to the scale of the project and location. Features can be added or removed.
      iii. Committee members felt that photos of license plates would be more useful than immediate notification.
   - b. Raising Bridge to Increase Vertical Clearance
      i. Committee members had no issues with raising the truss to increase clearance. No need to cover steel members on the inside, as long as siding is covering the exterior.
5. Superstructure Alternatives: Glulam, Steel, or Concrete Deck Beams
   - a. HTA suggests there is not enough room at the Upper Cox Bridge for glulam beams due to hydraulics and would require large amounts of reconstruction of the pier at the Falls bridge.
   - b. HTA's recommendation is:
      i. Upper Cox Bridge – Steel due to insufficient room for glulam beam and concerns with durability of timber decking on concrete deck beams.
      ii. Lower Cox Bridge – Either glulam or steel would be feasible alternatives.
      iii. Northfield Falls Bridge – Steel due to insufficient room for glulam beam at the pier and concerns with durability of timber decking on concrete deck beams.
   - c. Committee feels that the glulam timber beam at the Lower Cox Bridge could be considered PTN 4 and would be a demonstration of this type of treatment for future projects.
   - d. John Weaver has provided additional suggestions for attaching timber deck to concrete deck beams, but there is still durability concerns regarding trapped moisture.

e. Committee Agrees on the following superstructure alternatives:
    i. Upper: Steel beams
    ii. Lower: Glulam beams
    iii. Falls: Steel beams
f. Are there concerns about vertical deflection?
    i. Yes, HTA will need to detail a lateral brace connection that allows for differential vertical movement.
g. Include signage at the bridge explaining the different structural replacement types being used – see Williamstown for an example.

6. Action Items:
    a. HTA will evaluate glulam beam
    b. HTA to perform final hydraulics. This is a new scope item and VTrans will follow up with additional details.
    c. HTA will report back once bids are received for the detection system in the Maine project.
    d. HTA will follow up with HCBPC with form liner details during final design.

APPENDIX I

VTrans Resource ID Memos

Jessie Johnson
VTrans Biologist
State of Vermont
Environmental Section
Barre City Place
219 Main St.
Barre City, VT 05641
https://vtrans.vermont.gov/

Agency of Transportation

To: File
From: Jessie Johnson, VTrans Biologist
Date: Friday, September 22, 2023
Subject: Northfield BO CVBR(8) Natural Resource ID

I have completed natural resource identification for Northfield BO CVBR(8). This project is located on covered bridge 11 on TH-3 Cox Brook Rd in Northfield, Vermont. My evaluation has included wetlands and watercourses, wildlife habitat, agricultural soils, and rare, threatened, and endangered species.

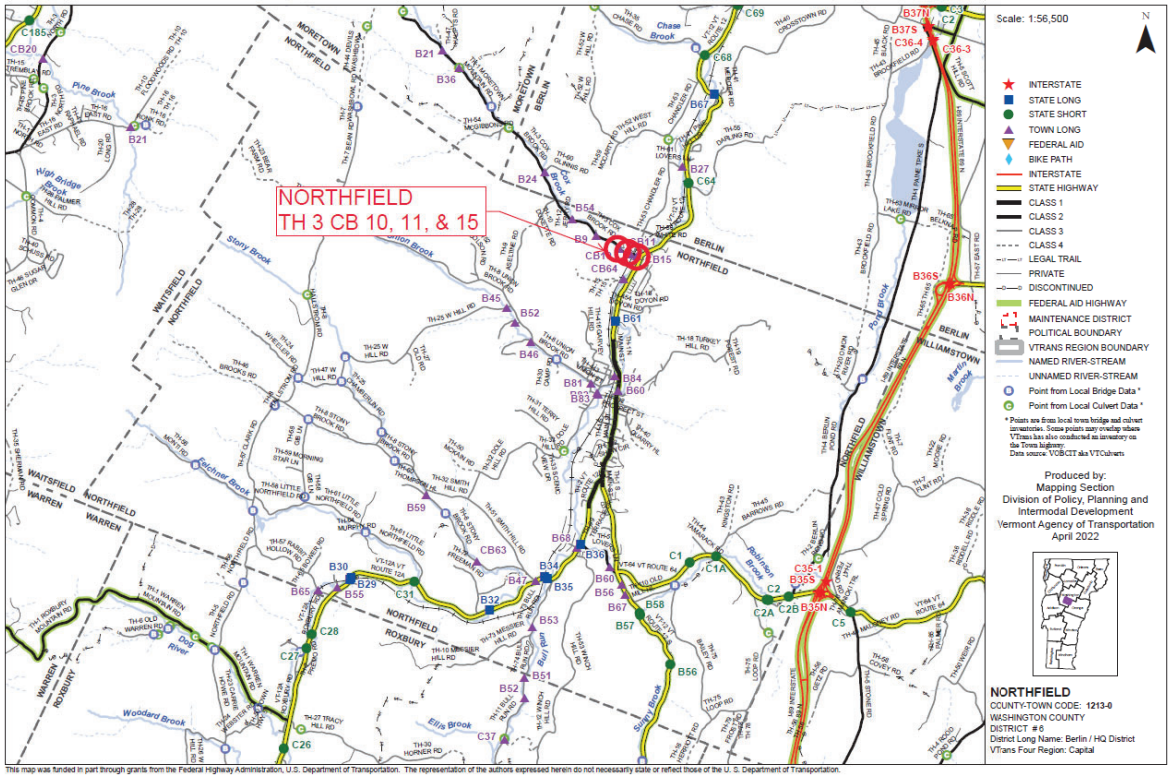


Figure 1: A map of Covered Bridges 10, 11, and 15.

Wetlands and Watercourses
I have reviewed existing VSWI, Advisory Wetland Mapping, and USFWS Wetland Mapper and have discovered that no wetlands are found within the vicinity of the project. Cox Brook, a tributary of the Dog River, flows under bridge 11.

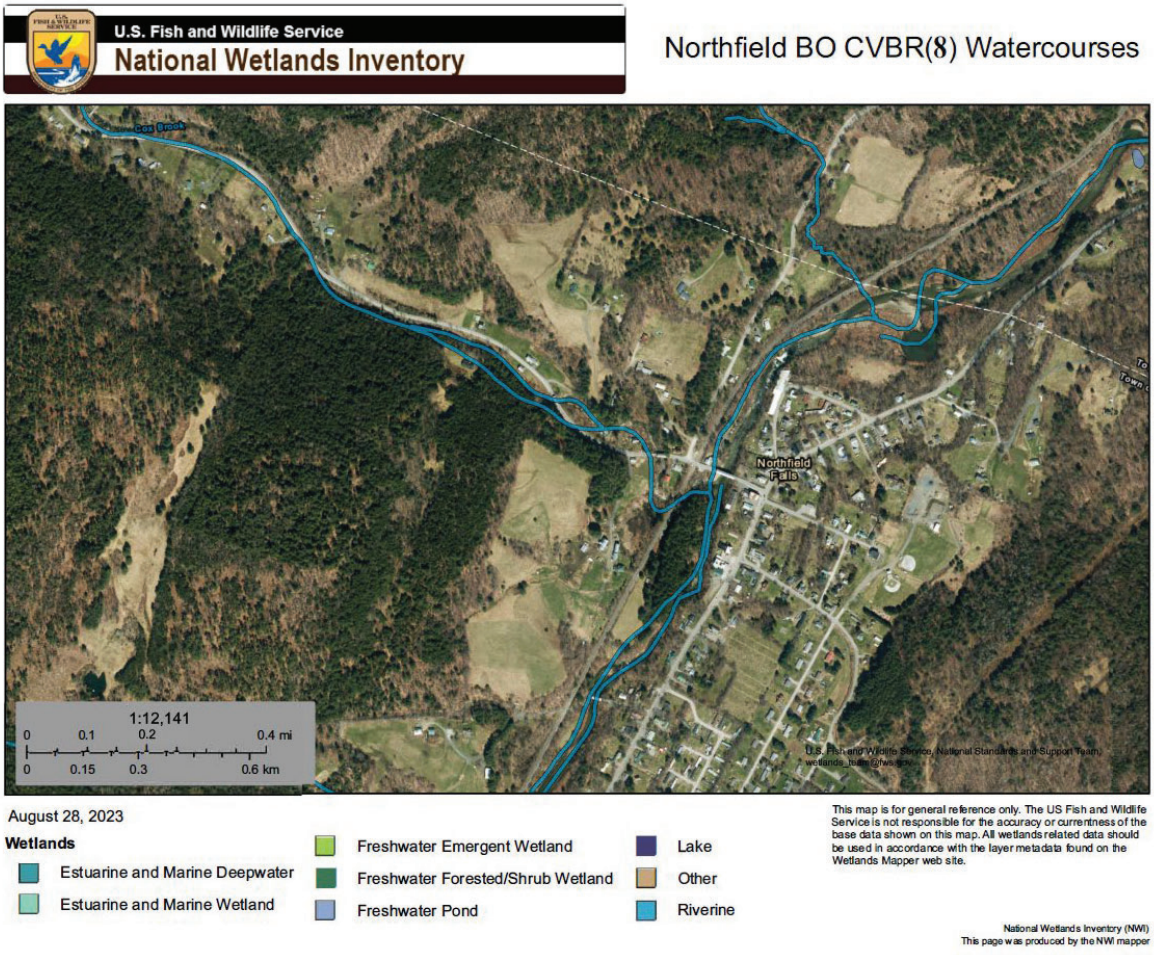
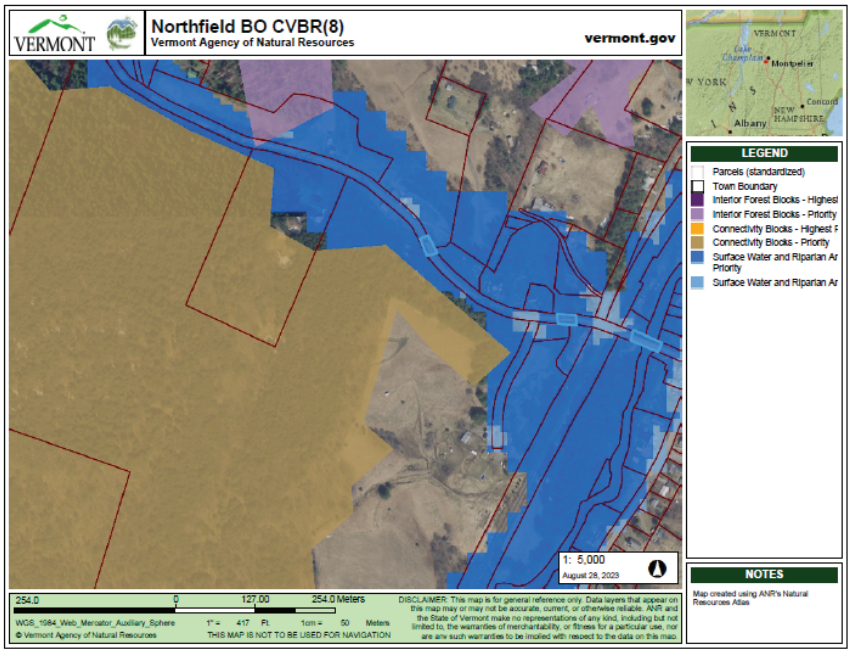
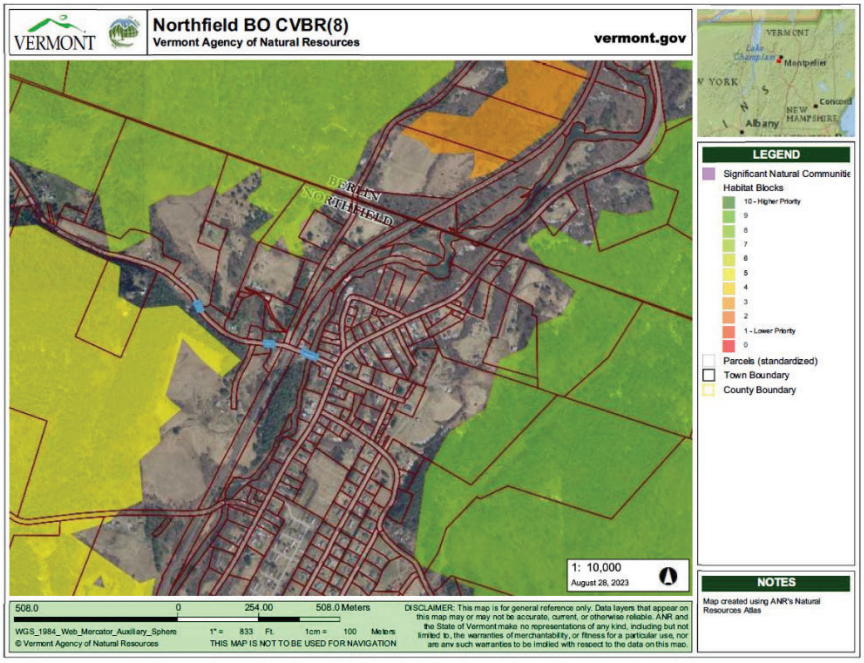


Figure 2: A map of Cox Brook and other associated watercourses near the project location.

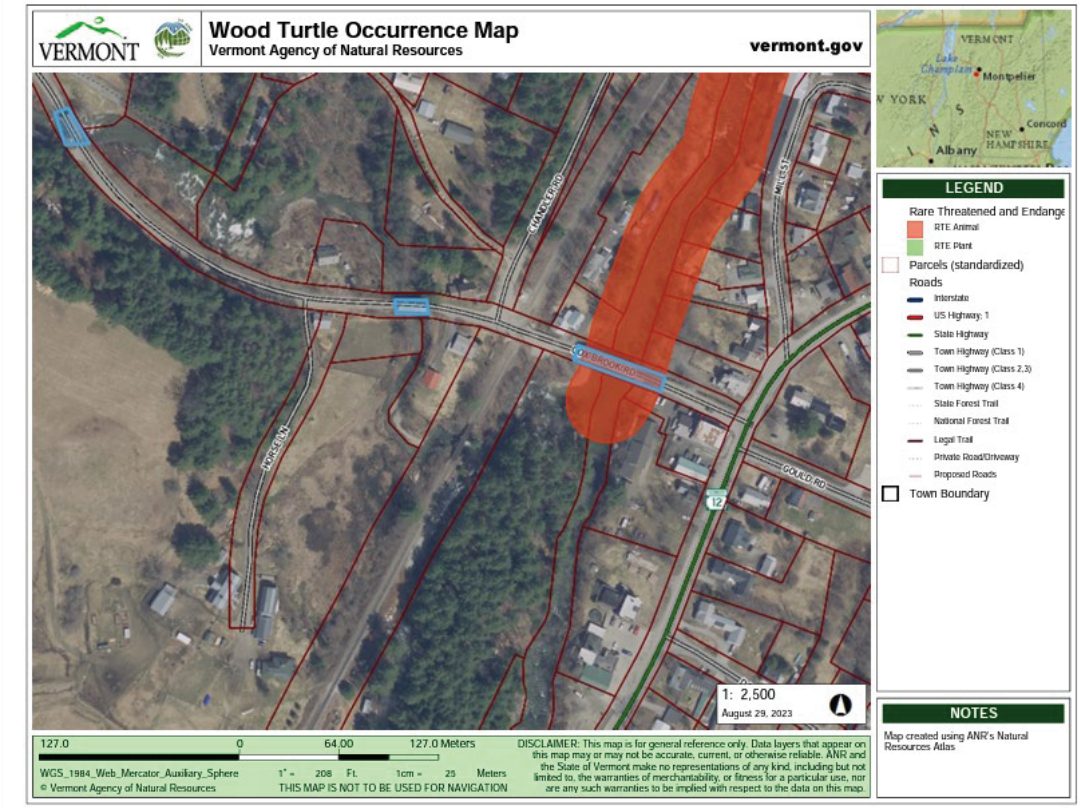
Wildlife Habitat
There are three habitat blocks surrounding the project location. The area ranks high for surface water riparian community connectivity as well as has a high priority connectivity block adjacent to it. AOP should be prioritized by the design team on this project.





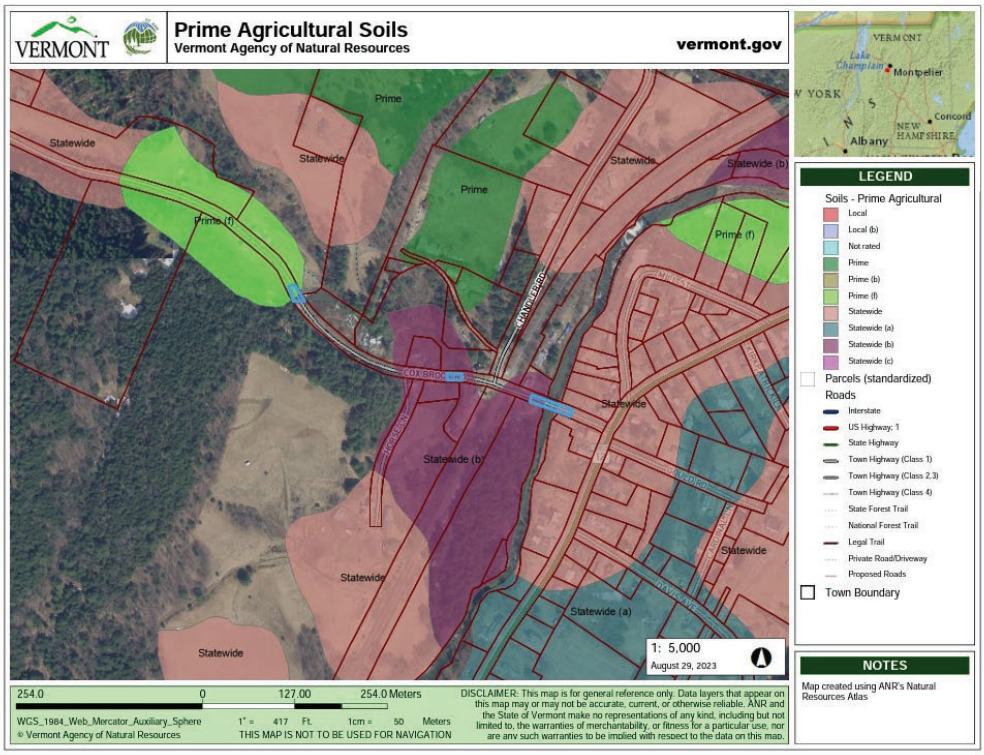
Rare, Threatened, and Endangered Species

The Vermont ANR atlas detected an occurrence record of a wood turtle (*Glyptemys insculpta*) under bridge 15, but not under bridge 11. However, the watercourses are connected and a wood turtle survey should be conducted. I queried the USFWS IPaC Website and found that the project is within the range of the federally endangered Northern long eared bat. The IPaC FHWA determination key yielded a result of <u>may effect, not likely to adversely effect</u> the Northern long eared bat. No critical habitat was detected near the project location.



Agricultural Soils

Rumney fine sandy loam, 0 to 3 percent slopes, frequently flooded, Nicholville very fine sandy loam, 3 to 8 percent slopes, and Colton gravelly sandy loam, 8 to 15 percent slopes are all considered prime statewide soils and are mapped in the vicinity of the project. Ondawa fine sandy loam, 0 to 3 percent slopes, frequently flooded, is a prime agricultural soil and is mapped around bridge 10.

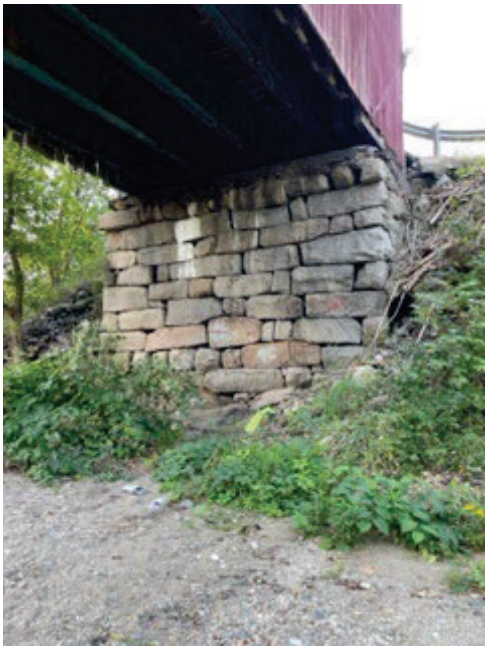

VERMONT
Prime Agricultural Soils
Vermont Agency of Natural Resources
vermont.gov
Statewide
Prime
Prime (f)
Statewide (b)
Statewide (a)
COX BROOK
MINOR BROOK
1: 5,000
August 29, 2023
254.0 0 127.00 254.0 Meters
WGS_1984_Web_Mercator_Auxiliary_Sphere
© Vermont Agency of Natural Resources
1" = 417 Ft. 1cm = 50 Meters
THIS MAP IS NOT TO BE USED FOR NAVIGATION
DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.
VERMONT
Lake Champlain
Montpelier
Albany
Concord
NEW HAMPSHIRE
LEGEND
Soils - Prime Agricultural
Local
Local (b)
Not rated
Prime
Prime (b)
Prime (f)
Statewide
Statewide (a)
Statewide (b)
Statewide (c)
Parcels (standardized)
Roads
Interstate
US Highway; 1
State Highway
Town Highway (Class 1)
Town Highway (Class 2,3)
Town Highway (Class 4)
State Forest Trail
National Forest Trail
Legal Trail
Private Road/Driveway
Proposed Roads
Town Boundary
NOTES
Map created using ANR's Natural Resources Atlas

Pictures of Bridges 10, 11, and 15:

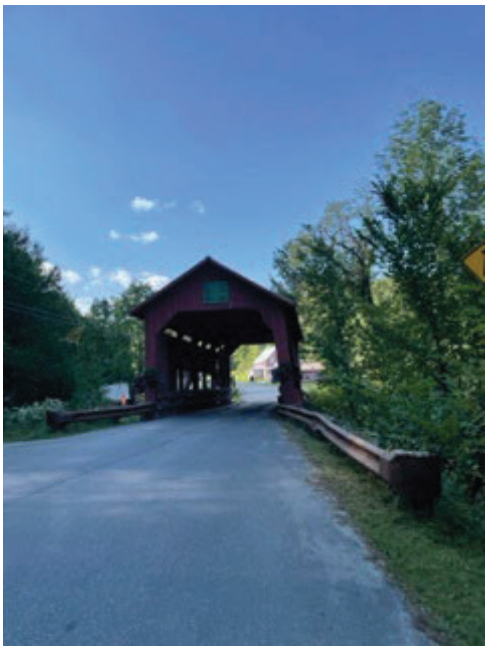
Bridge 10, taken on 9/6/2023

The underside of bridge 11. Taken 9/6/2023

Cox Brook and the surrounding shoreline near bridge 11.



A picture of the underside of bridge 10, taken of 9/6/2023



A picture of bridge 10, taken on 9/6/2023

A picture of bridge 15 from google earth

APPENDIX J

Local and Regional Input Questionnaire

Project Summary

These projects, BO CVBR(7), BO CVBR(8), & BO CVBR(9) focus on covered bridges 10, 11, & 15 (Northfield Falls Covered Bridge, Lower Cox Brook Covered Bridge, & Upper Cox Brook Covered Bridge) on Town Highway 3 (Cox Brook Rd.) in Northfield, Vermont. The bridges are deteriorating and need either a major maintenance action or replacement. Potential options being considered for this project include targeted repairs, safety and girder upgrades, replacement with new covered bridges, and replacement with new non-covered bridges. It is possible that VTrans will recommend a road closure and detour traffic away from the project sites for the duration of the work.

Community Considerations

1. Are there regularly scheduled public events in the community that will generate increased traffic (e.g. vehicular, bicycles and/or pedestrians), or may be difficult to stage if the bridge is closed during construction? Examples include annual bike races, festivals, parades, cultural events, weekly farmers market, concerts, etc. that could be impacted? If yes, please provide approximate date, location and event organizers' contact info.

   During summer and fall months numerous tourists visit the three covered bridges. In addition, there are bike and bus tours to and across the bridges during these times.

2. Is there a "slow season" or period of time from May through October where traffic is less or no events are scheduled?

   Winter and Spring months.

3. Please describe the location of the Town garage, emergency responders (fire, police, ambulance) and emergency response routes that might be affected by the closure of the bridge, one-way traffic, or lane closures and provide contact information (names, address, email addresses, and phone numbers.

   The Highway Department and emergency service providers are located approximately four miles from the project site. A long-term closure would create a three-to-four-mile detour for these service providers. Also, these providers would need to detour onto Aseltine Road which is a gravel road that includes narrow road sections.

4. Are there businesses (including agricultural operations and industrial parks) or delivery services (fuel or goods) that would be adversely impacted either by a detour or due to work zone proximity?

   Cox Brook Road is a Class Two Town Highway that connects Northfield to Berlin and Moretown. As a result, there are numerous commercial and passenger vehicles that travel on this section of road. During a bridge closure, these vehicles would need to detour onto Aseltine Road which is a gravel road with narrow road sections.

   The Falls General Store is located on Route 12 near the first covered bridge, and during summer and fall months benefits from tourists and visitors to the three covered bridges.

5. Are there important public buildings (town hall, community center, senior center, library) or community facilities (recreational fields, town green, etc.) close to the project?

   No.

6. What other municipal operations could be adversely affected by a road/bridge closure or detour?

   None.

7. Are there any town highways that might be adversely impacted by traffic bypassing the construction on other local roads? Please indicate which roads may be affected and their condition (paved/unpaved, narrow, weight-limited bridges, etc), including those that may be or go into other towns.

   During a bridge closure, vehicles would need to detour onto Aseltine Road which is a gravel road with narrow road sections. This road is not designed to accommodate significant traffic over an extended period.

8. Is there a local business association, chamber of commerce, regional development corporation, or another downtown group that we should be working with? If known, please provide name, organization, email, and phone number.

   Town Staff can coordinate with the local businesses.

9. Are there any public transit services or stops that use bridges or transit routes in the vicinity that may be affected if they become the detour route?

   No.

Schools

1. Where are the schools in your community and what are their yearly schedules (example: first week in September to third week in June)?

   Schools are located approximately four miles from the project site and typically start the last week of August and end the year the second week of June.

2. Is this project on specific routes that school buses or students use to walk to and from school?

   School buses operate in this area and will need to select an alternate route during a bridge closure which would add 10 to 15 minutes to the trip.

3. Are there recreational facilities associated with the schools nearby (other than at the school)?

   No.

Pedestrians and Bicyclists

1. What is the current level of bicycle and pedestrian use on the bridges?

   There are significant levels of bicycle and pedestrian use on the bridges.

2. Are the current lane and shoulder widths adequate for pedestrian and bicycle use?

   Limited.

3. Does the community feel there is a need for a sidewalk or bike lane on any of the bridges?

   Yes.

4. Is pedestrian and bicycle traffic heavy enough that it should be accommodated during construction?

   Yes.

5. Does the Town have plans to construct either pedestrian or bicycle facilities leading up to the bridges? Please provide any planning documents demonstrating this (scoping study, master plan, corridor study, town or regional plan).

   No.

6. In the vicinity of the bridges, is there a land use pattern, existing generators of pedestrian and/or bicycle traffic, or zoning that will support development that is likely to lead to significant levels of walking and bicycling?

   No.

Design Considerations

1. Are there any concerns with the alignment of the existing bridge? For example, if a bridge is located on a curve, has this created any problems that we should be aware of?

   The road alignment approaching the third covered bridge has a slight angle and added to the narrowness and height of the bridge results in vehicles hitting the bridge several times a year.

2. Are there any concerns with the widths of any of the existing bridges?

   See above.

3. Are there any special aesthetic considerations we should be aware of?

   The three covered bridges have significant historical and cultural value for the Town of Northfield and that heritage needs to be preserved.

4. Do any of the locations have a history of flooding? If yes, please explain.

   There is a history of high water during heavy rainstorms on the Dog River in area of the three bridges. There is no record of the bridges being displaced or severely impacted by flood waters. During Storm Irene a tree lodged into the third covered bridge causing minor damage.

5. Are there any known Hazardous Material Sites near the project sites?

   No.

6. Are there any known historic, archeological and/or other environmental resource issues near the project sites?

   No.

7. Are there any utilities (water, sewer, communications, power) attached to any of the existing bridges? Please provide any available documentation.

   No.

8. Are there any existing, pending, or planned municipal utility projects (communications, lighting, drainage, water, wastewater, etc.) near the project that should be considered?

   None.

9. Are there any other issues that are important for us to understand and consider?

   No.

Land Use & Zoning

1. Please provide a copy of your existing and future land use map or zoning map, if applicable.

   Attached.

2. Are there any existing, pending or planned development proposals that would impact future transportation patterns near the bridges? If so, please explain.

   No.

3. Is there any planned expansion of public transit or intercity transit service in the project area? Please provide the name and contact information for the relevant public transit provider.

   No.

Communications

1. Please identify any local communication outlets that are available for us to use in communicating with the local population. Include weekly or daily newspapers, blogs, radio, public access TV, Facebook, Front Page Forum, etc. Also include any unconventional means such as local low-power FM.

   Northfield News, Front Porch Forum, Town Web-Site

2. Other than people/organizations already referenced in this questionnaire, are there any others who should be kept in the loop as the project moves forward?