

Midtown Greenway Extension across Mississippi River
Bridge L5733
Pedestrian/Bicycle Trail Use Study



Feasibility Report

Prepared for:
Midtown Greenway Coalition

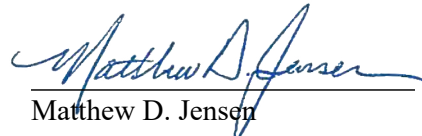
April 12, 2019

FEASIBILITY REPORT
FOR
MIDTOWN GREENWAY COALITION
GREENWAY EXTENSION OVER MISSISSIPPI RIVER
BRIDGE L5733
PEDESTRIAN/BICYCLE TRAIL USE STUDY



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I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



Matthew D. Jensen

April 12, 2019 License No. 44587

**MIDTOWN GREENWAY COALITION
SHORT LINE BRIDGE - BRIDGE L5733
MIDTOWN GREENWAY EXTENSION ACROSS MISSISSIPPI RIVER
PEDESTRIAN/BICYCLE USE STUDY FEASIBILITY REPORT**

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**MIDTOWN GREENWAY COALITION
SHORT LINE BRIDGE - BRIDGE L5733
MIDTOWN GREENWAY EXTENSION ACROSS MISSISSIPPI RIVER
PEDESTRIAN/BICYCLE USE STUDY FEASIBILITY REPORT**

EXECUTIVE SUMMARY

This Feasibility Report has been prepared for the Midtown Greenway Coalition (MGC) to evaluate the potential multi-use trail connection from the eastern end of the Midtown Greenway at West River Parkway eastward across the Mississippi River on the existing Short Line Bridge (Bridge L5733) as a regional connection to points east including the University of Minnesota, Allianz Field, and downtown St. Paul.

Bridge L5733 crosses the Mississippi River between Franklin Avenue and Lake Street in the City of Minneapolis. The existing bridge was constructed in 1902 by the Chicago, Milwaukee, St. Paul and Pacific Railroad. The bridge is currently owned by Canadian Pacific Railway which leases railroad operations to the Minnesota Commercial Railroad as an industrial spur line to South Minneapolis. The bridge is composed of three segments; the west approach over West River Parkway, the three main truss spans over the Mississippi River, and the east approach over East River Road.

The project included due diligence and information gathering about the bridge, two site visits of Bridge L5733 to determine the existing bridge geometry, condition, and to identify recommended improvements for converting or adding a pedestrian and bicycle facility to the structure.

The condition of the entire bridge was observed, and conditions were documented to determine the required improvements to facilitate partial or total use as a pedestrian and bicycle facility. Other components were evaluated based upon visual observations and previous inspection information provided by the Minnesota Department of Transportation (MnDOT).

Four alternatives are being considered to provide a shared use trail on the bridge:

1. Freight railroad ceases to operate. Bridge is converted to shared use trail.
2. Freight railroad continues to operate. Existing bridge rehabilitated. Shared use trail added.
3. Freight railroad continues to operate. Existing bridge partially reconstructed. Shared use trail added.
4. Freight railroad continues to operate. Supplemental structure with shared use trail added above existing bridge

A cost estimate was developed for the alternatives considered to facilitate the desired use.

Financing or funding sources have not been secured beyond the fundraising used to provide this study. One intention of this study is to provide information needed to solicit funding for the desired improvements. It is not known what environmental documentation process may be required or the permits and approvals that may be needed to allow this project to proceed. Any future construction activities will need to be coordinated with the current or future owner of the bridge.

The improvements to Bridge L5733 are included as a part of this project are detailed in this report along with estimated costs. The estimated project costs include a contingency allowance and estimates for indirect costs such as engineering, permitting, and construction phase services.

1. INTRODUCTION

On June 15, 2018, the Midtown Greenway Coalition (“MGC” or “Client”) authorized the preparation of a feasibility report for the Short Line Bridge (Bridge L5733) over the Mississippi River in Minneapolis, Minnesota. This Feasibility Report has been prepared for the Client’s use to understand feasibility to add a shared use trail to the existing bridge and associated costs. The project includes conducting one site visit for drone imaging support, one structural site visit, and providing a discussion of feasibility and associated opinion of costs to add a shared use trail (bicycle & pedestrian use) to the existing railroad bridge. A project location map and site photos are provided in Appendix A and Appendix B.

A previous study of extending the Midtown Greenway over the Mississippi River was completed in September 2006 for Hennepin County by URS Corporation. This report considered several options to cross the river, including the use of the existing Short Line Bridge and new bridges on new alignments adjacent to the existing railroad bridge. The report explores reuse of the existing railroad bridge but recommends not considering reuse of the existing bridge due to “...long-term maintenance, railroad easement/lease costs, railroad operational liability, structural integrity (Pin Connected Eye Bar), structural compatibility (modern vs. 125 yr old) and fire risk issues.” This report acknowledges these concerns, however since 2006 there have been significant developments in understanding and mitigation of structural concerns on fracture critical bridges.

The Twin Cities area has several examples of pin connected truss bridges carrying pedestrians:

- Boom Island Railroad Bridge
- Northern Pacific Railroad Bridge No. 9
- Hanover Bridge

This report provides four alternatives that could consider reuse of all or parts of the existing bridge and mitigates the structural integrity risk by providing structural redundancy of the existing truss.

The MGC is exploring the feasibility to add pedestrian and bicycle use to Bridge L5733 to allow regional trail connectivity to other existing and proposed trail corridors east of the Mississippi River. Bridge L5733 was originally constructed in 1902 by the Chicago, Milwaukee, St. Paul and Pacific Railroad (Milwaukee Road) and is currently owned by Canadian Pacific Railway (CP Rail) which leases railroad operations to the Minnesota Commercial Railroad as an industrial spur line to businesses in South Minneapolis. The railroad typically operates one train per day over the structure.

The bridge is composed of three superstructure units shown below in Table 1.

| Unit of Bridge L5733 | Length (feet)* | Superstructure Type |
|---|-----------------------|----------------------------|
| West Approach (Span 1 over W River Pkwy) | 72 | Steel Plate Girders |
| Main Truss (Spans 2-4 over Mississippi River) | 843 | Steel Deck Truss |
| East Approach (Span 5-6 over E River Rd) | 162 | Steel Plate Girders |

Table 1: Superstructure Units

* Bridge geometry determined from LiDAR data

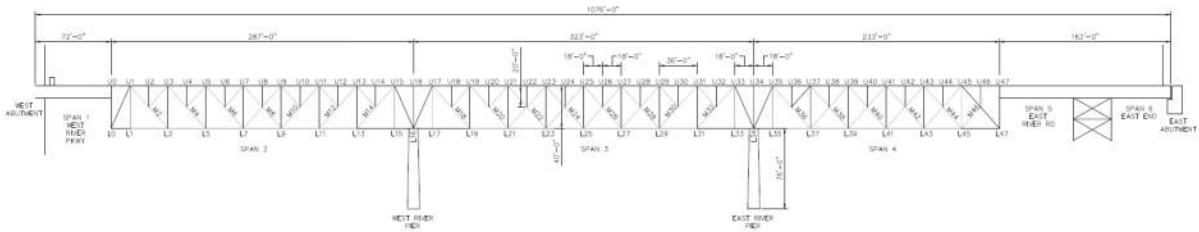


Figure 1: Overall Bridge Elevation looking North (See Appendix C1 for larger view)



Figure 2: Project Location

Bridge L5733 has one west approach deck girder span (Span 1), three deck truss spans over the main river gorge (Spans 2-4), and two east approach deck girder spans (Spans 5-6) for a total bridge length of 1076 feet long.

2. OBSERVED CONDITIONS

The bridge owner would not permit direct access to the bridge. In addition, no plans have been made available for the bridge. During the planning for this study, a new technology was identified to provide information on the bridge geometry, condition, and imagery that would provide a baseline to understand observed condition of the bridge. The new technology implemented was an Unmanned Aircraft System, or Drone, with LiDAR and photo imagery capabilities. The LiDAR information provides the geometry of the in-place bridge and the still imagery provides information on the existing condition.

The MGC hired Performance Drone Services (PDS) of Edina, MN to conduct the Aerial LiDAR Acquisition & Post Processing, and the aerial media and still imagery of Bridge L5733. The aerial LiDAR acquisition was completed on July 18, 2018. After the raw data was processed, this information was provided September 28, 2018. This information was viewed and discussed by the engineering team and formed the basis to document the condition of the bridge.

A structural site visit was completed on October 4, 2018, to review the condition of Bridge L5733. Access to the site via the east and west banks of the Mississippi and East River Road and West River Parkway. The railroad has security gates installed at each end of the bridge that are remotely controlled to provide railroad access across the structure.

The bridge cross section consists of an open deck floor system supporting one track. The original bridge had two tracks, but the south track has been removed and a walkway and cable railing has been installed on the south side and adjacent to the existing track.

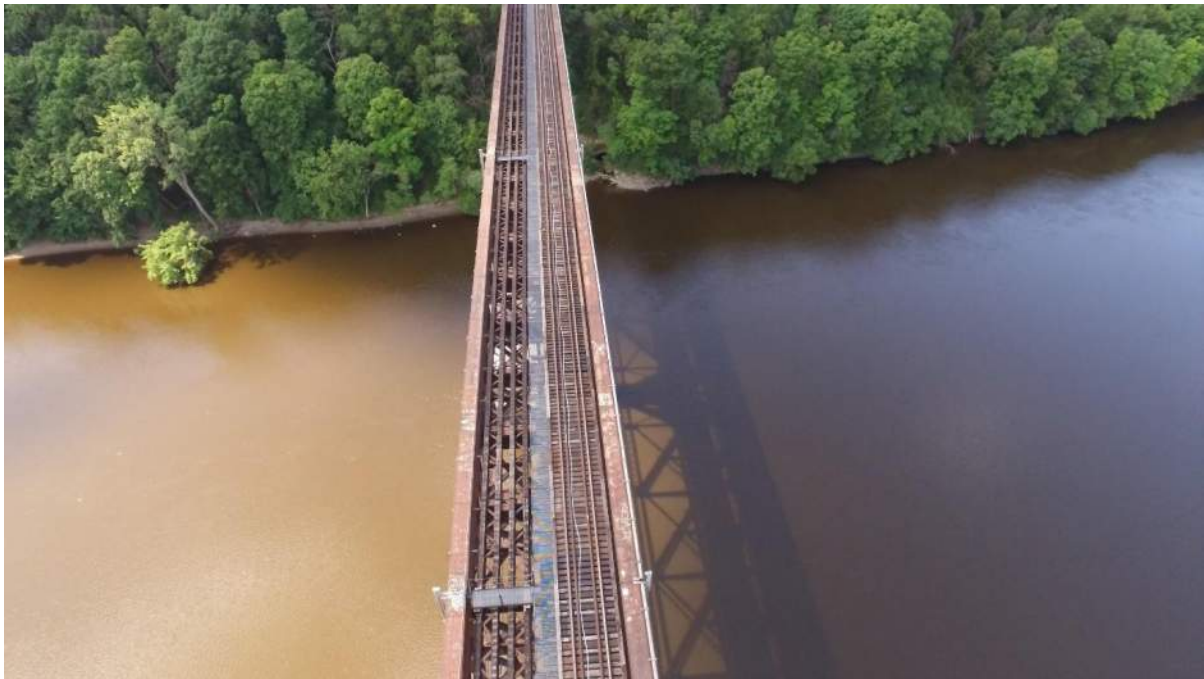


Figure 3: Top Section view looking from above towards the west river bank

West Approach (Span 1)

The west approach, Span 1, of Bridge L5733 consists of one span deck plate girder span supported by the cast-in-place concrete west abutment and a steel pier supported to the same elevation as the L0 panel point of the main truss span. A large concrete retaining wall supports the West River Parkway and trail embankment.

The superstructure consists of two deck plate girders, six floor beams, and eight stringers. All superstructure metal components have full paint system loss and heavy corrosion. No significant section loss was observed, but localized section loss is identified in the bridge inspection report.

The substructure consists of the west abutment and the steel pier. The abutment concrete is in good to fair condition, with some cracking and evidence of seepage on the backwall. The bearing areas appear sound. The steel pier supporting the east end of Span 1 in similar condition to the Span 1 superstructure. The foundation for the steel pier was not visible.



Figure 4: West Approach, Span 1 looking south

Main Truss (Spans 2-4 over Mississippi River Gorge)

The main truss spans over the Mississippi River Gorge consist of three Baltimore deck truss spans, with a floor system and stringers supporting the railroad track and floor decking system. The trusses are supported at each river bank on concrete foundations as well as two masonry piers within the river.

Steel Truss Members

The trusses are a type of Pratt truss that provide additional bracing to the compression members (top chord with a deck truss) that help the compression members resist buckling and help to control deflection. For Bridge L5733, the top chord and vertical members are typically in compression, while the bottom chord and diagonals (except near supports) are in tension.

Tension members in a truss bridge are considered “Fracture Critical Members” (FCM). The current National Bridge Inspection Standards (NBIS) definition for a FCM is "a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse." The FCM on the truss spans are primarily eyebars

connected to adjacent members with steel pins, which is a typical practice from the era this bridge was constructed.

FCM elements require detailed ultrasonic inspection to monitor and verify the viability of these components. As this is a railroad bridge, it is not known if the FCMs on Bridge L5733 have had in-depth inspection of these elements in the past. This report has not identified any required repairs. Future inspections will be required to identify the specific condition and monitor the condition of these elements.

The trusses are 40-ft deep and have a typical 36-ft spacing between the main panel points.



Figure 5: Main Truss Spans 2-4 over River looking North

The following figure provides the FCM for Bridge L5733, which is also provided in Appendix C1 at a larger scale.

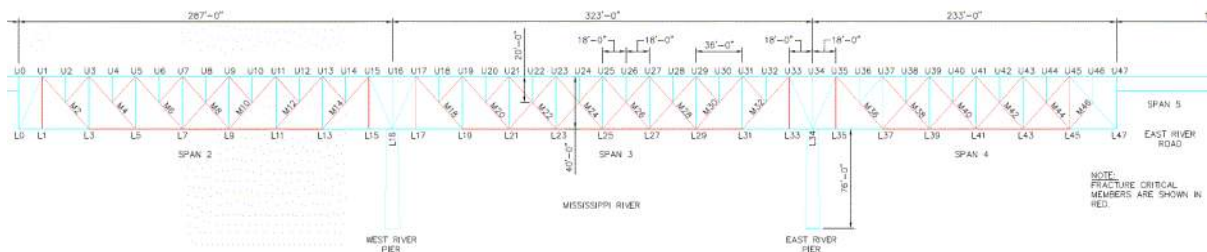


Figure 6: Fracture Critical Members (See Appendix C1 for larger view)

The Main Truss Unit was visually observed from the ground level only and through the imagery provided by the UAS flight. In general, the main truss is in fair condition. Tension members consist 2 to 8 individual eyebars per member, and compression members are built up members consisting of plate, channels, angles, batten plates and lacing plates connected by rivets. There is full paint system failure, scale and corrosion prevalent across the trusses,

pack rust, and spot section loss that is likely reducing the overall capacity of the truss spans. Based upon the observed condition to these members, this report assumes that repairs will be required to restore the required capacity.

Truss Floor System

All floor system elements were reviewed as was available via binoculars from the river banks. The floor system consists of 8 stringers (4 per track) supported by floor beams connected to the trusses at each panel point. The paint system is compromised throughout the bridge floor system, but minimal section loss is assumed due to the lack of chlorides used on railroads. Minimum steel strengthening improvements are assumed to be required and are included in the repair scope of work. Based upon visual site observations, this report assumes the no major structural improvements will be required to the truss floor system.

Truss Substructures

The truss spans are founded on Piers located at Panel Point L0, L16, L34, and L47. The piers at L0 and L47 concrete foundations located near the lower chord at the top of the river bluffs on each side of the Mississippi River. The western bluff pier footing was not visible, as they were covered by accumulated debris around the truss bearings. The eastern bluff pier footing is cast-in-place concrete with minor spalling and deterioration.

The two river piers are masonry wall piers with cast-in-place concrete caps. According to the most recent underwater inspection report for Bridge L5733, the river piers are in good condition with no significant defects. The stone masonry was in good condition. No vertical footing exposure was observed in the river channel. The channel bottom appeared stable with no significant scour observed and with minimal changes since the last inspection. No action to mitigate this local scour is included in the improvements. The piers visually are in good condition and no improvements are recommended.

This report assumes no improvements are required to the truss substructures.

Other components

The truss has other important components that were visually inspected that this report assumes no improvements will be required. These include the following:

- Truss lateral bracing below the floor system
- Truss lateral bracing at the lower chord
- Truss sway bracing at each panel point

East Approach (Span 5 & 6)

The east approach, Spans 5 and 6 of Bridge L5733, consists of two deck plate girder trestle spans supported by a steel pier supported to the same elevation as the L47 eastern end of the main truss span, a steel trestle pier and the cast-in-place concrete east abutment.

The Span 5 and 6 superstructure consists of two deck plate girders, six floor beams, and eight stringers, similar to the West Approach. All superstructure metal components have full paint system loss and heavy corrosion. No significant section loss was observed, but localized section loss is identified in the bridge inspection report. There are some deformed members at the east abutment due to direct loading of the ends of the plate girders from the backwall of the east abutment.



Figure 7: Span 5 looking north over East River Road, Span 6 obscured by vegetation

The substructure consists of the two-column steel pier near L47, the four-column trestle pier, and the east abutment. The abutment concrete is in fair to poor condition due to the issues with the backwall pressure on the superstructure and evidence of seepage on the backwall. The bearing areas appear sound. The steel piers supporting the west end of Span 5 is in similar condition to the Span 5 and 6 superstructure. The foundation for the steel pier was not visible.

Existing Bridge Capacity Commentary

Railroad bridges over public right of ways are not required to be load rated by the Minnesota Department of Transportation (MnDOT), therefore no load rating information is available from MnDOT. The Federal Railroad Administration requires a bridge owner's railroad engineer to verify the capacity of the bridge is greater than the loads operated on a bridge.

The bridge owner has chosen not to provide any information regarding the bridge, therefore this study can only assume that the existing bridge capacity is sufficient for the railroad loads operated upon the bridge. Currently the bridge supports one freight railroad track. The freight railroad load is greater than the desired shared use trail, assuming the freight railroad no longer operates on the bridge.

For other alternatives that have shared use of the bridge with freight railroad and bicycle/pedestrian facilities, this study assumes strengthening of the bridge would be required. These improvements are described in Section 3. This report also identifies detailed structural inspection and structural analysis in later phases of the project to retire the risks assumed within this study.

3. PROPOSED IMPROVEMENT ALTERNATIVES

The goal of the MGC is to facilitate extension of the current Midtown Greenway across the Mississippi River on Bridge L5733. There are four alternatives that are being considered to provide a shared use trail on the bridge:

1. Freight railroad ceases to operate. Bridge is converted to shared use trail.
2. Freight railroad continues to operate. Existing bridge rehabilitated. Shared use trail added.
3. Freight railroad continues to operate. Existing bridge partially reconstructed. Shared use trail added.
4. Freight railroad continues to operate. Supplemental structure with shared use trail added above existing bridge

Consistent Alternative Parameters

To be consistent with comparisons across these alternatives, the following parameters are held constant across all alternatives:

- Shared use trail (bicycle & pedestrian use facility) is the desired use.
- Deck width is twelve feet, the standard bridge width for bicycle/pedestrian facilities.
- Decking material is a lightweight aluminum planking that permits water to flow through the deck and minimizes loading on the bridge.
- Bridge railings are 10-ft tall code compliant metal railings for railroad separation and to mitigate access to non-permitted areas on the bridge (deter climbing).
- Bridge railings are 4.5-ft tall code compliant metal railings for fall protection where railroad protection is not required.
- Off-bridge improvements are generally not included unless specifically identified.
- Bridge lighting is provided. (trail lighting only, no aesthetic lighting)
- Signage or trail wayfinding or emergency telephones are located off the bridge.
- Planters and/or benches are not assumed to be provided on the bridge.
- No separation curbs/barriers/protection between bicycles and pedestrian.
- Existing bridge painting is not included.
- At each end of the bridge, bollards will limit vehicles from accessing the bridge.
- Emergency or maintenance vehicles are permitted through controlled access.
- Accumulated snow is assumed to be cleared with the design maintenance vehicle.
- No preventative or long-term maintenance activities or costs are included.

During project development, some or all of these assumptions can be revised or adapted based upon the desired use and functionality of the bridge. Parameter changes will have a direct impact on project costs.

Structural Inspection and Structural Analysis Assumption

All alternatives will require a structural inspection and structural analysis to understand the inherent existing bridge load capacity and demand based upon the intended use for each alternative. This study assumes a full structural inspection will be provided as the project is developed to confirm existing bridge conditions, as they will likely deteriorate from the work of this study, and identify all bridge defects and section loss used to model the actual condition of the bridge. These defects will be used in the structural analysis to determine the

modeled bridge load capacity and the modifications necessary to provide for each alternative intended use.

Bridge Redundancy and Risk Assumption

This existing bridge is considered “Fracture Critical”, meaning the bridge does not inherently have enough redundancy to resist total collapse if a fracture critical member of the bridge fails. For Bridge L5733 the FCMs are the eyebars and pins found throughout the structure. Future owners of the bridge may not choose to accept a structure with this level of risk, and therefore bridge improvements may be required to provide adequate redundancy to mitigate this risk. This report will provide some level of analysis for each option on how to provide a redundant structure to mitigate this risk for a potential future owner.

Proposed Improvements for Alternatives

The following is a description of the proposed improvements considered to provide Bridge L5733 to allow pedestrian and bicycle use. The following items describe the proposed improvements and assumptions for each alternative. The scope of this study did not provide for project graphics, or illustrations of the following alternatives. Graphics shown were provided by the client.

Alternative 1: Cease Freight Rail Operation, Convert to Shared Use Trail

This alternative considers that CP Rail ceases railroad operation across the bridge and abandon the existing railroad right of way. The timing of this scenario is unknown and may not be on the near-term horizon.

A. Shared Use (Bicycle and Pedestrian) Trail Layout

The bridge deck would be placed on the structure to maximize the load distribution to the bridge. This would likely be centered on one of the two existing track alignments on the north or south side of the bridge width.

B. Safety

4.5-ft tall metal railings would be provided along the edge of deck for the length of the bridge, with access to the river navigational beacons as required.

C. Trail Connectivity

The existing Midtown Greenway could directly connect to the west end of the bridge with minimal grade change. At the east end of the bridge, the trail could connect directly to the existing railroad grade.

D. Railroad Agreements

This study is not able to speak to the acquisition of the railroad right-of-way, but acknowledges that some level of effort will be required to acquire the right of way for the bridge.

E. Bridge Redundancy and Risk Mitigation Strategy

For the bridge to be considered redundant, a strategy to provide internal redundancy must be developed to mitigate the risk of FCM failure and bridge collapse. One strategy that may be considered would be to provide redundant tension members adjacent to the existing eyebars and redundant load transfer

mechanisms at the pin connectors. This study assumes a base-line cost to develop and design the redundancy strategy, and a construction cost to implement.

The 12-ft shared use trail live loading is significantly less than the original two track freight railroad loading. A structural inspection and structural analysis will be required to understand the inherent bridge load capacity and demand based upon the intended use. This study assumes these inspection and analysis is provided as the project develops and carries a cost for these efforts.

F. Aesthetic, historical, and viewshed impacts

This alternative has no significant negative aesthetic, historical, or viewshed impacts. Structural improvements are only those required for bridge load capacity and are not anticipated to affect bridge aesthetics or the historic fabric of the bridge. Users can experience unimpeded views to the north and south above the safety railing.

Alternative 2: Rehabilitate Bridge to provide Freight Rail and Shared Use Trail

This alternative considers that CP Rail continues railroad operation across the bridge and the existing bridge is rehabilitated to provide continued freight rail use with a shared use trail adjacent to the existing railroad track and railroad walkway separated by tall fence. This option is only feasible if the railroad can agree to permit the desired use on their right of way.

A. Shared Use (Bicycle and Pedestrian) Trail Layout

The bridge deck would be placed on south side of the bridge with the trail width potentially limited by the railroad's use of the existing bridge deck width. This alternative assumes the full 12-ft wide shared use trail section is provided and may need to extend past the south fascia of the bridge.

B. Safety

A 10-ft tall metal railing would be used between the trail and railroad for use separation along the length of bridge. A 4.5-ft tall metal railing would be provided along the south edge of deck for the length of the bridge, with access to the river navigational beacons as required.

C. Trail Connectivity

The existing Midtown Greenway could directly connect to the west end of the bridge with minimal grade change. At the east end of the bridge, the trail could connect directly to the existing railroad grade.

D. Railroad Agreements

This study is not able to comment to what agency or organization may advocate and convince the railroad to permit this joint use of their facility. There has been successful joint use of railroad bridges in the US, but most railroads have no interest in accepting additional cost, risk, or operational impacts.

E. Bridge Redundancy and Risk Mitigation Strategy

For the bridge to be considered redundant, a strategy to provide internal redundancy must be developed to mitigate the risk of FCM failure and bridge collapse. One strategy that may be considered would be to provide redundant tension members adjacent to the existing eyebars and redundant load transfer

mechanisms at the pin connectors. As compared to Alternative 1, due to the addition of the freight railroad load there will be significant additional efforts to provide this load trail redundancy. This study assumes an increased cost to develop and design the redundancy strategy, and a greater construction cost to implement.

F. Aesthetic, historical, and viewshed impacts

This alternative has negative aesthetic, historical, or viewshed impacts. The separation fence between the railroad and the trail will impact the visual aesthetics of the bridge and the viewshed to the north. Structural improvements are only those required for bridge load capacity and are not anticipated to affect bridge aesthetics or the historic fabric of the bridge.

Alternative 3: Partially Reconstruct Bridge to provide Freight Rail and Shared Use Trail

This alternative considers that CP Rail continues railroad operation across the bridge and the existing bridge is reconstructed on the existing river piers. This would provide a new bridge structure and railroad/trail use similar to Alternative 2, except on a new bridge. This alternative would provide continued freight rail use with a shared use trail adjacent to the existing railroad track and railroad walkway separated by tall fence. This alternative would reconstruct the bridge superstructure on the existing river piers and abutments. The new bridge superstructure could be reconstructed with a load trail redundant superstructure. This option is only feasible if the railroad can agree to permit the desired use on their right of way.

A. Shared Use (Bicycle and Pedestrian) Trail Layout

The bridge superstructure would be designed to provide adequate width for the railroad operations (track and walkway) and the desired 12-ft wide shared use trail.

B. Safety

A 10-ft tall metal railing would be used between the trail and railroad for use separation along the length of bridge. A 4.5-ft tall metal railing would be provided along the south edge of deck for the length of the bridge, with access to the river navigational beacons as required.

C. Trail Connectivity

The existing Midtown Greenway could directly connect to the west end of the bridge with minimal grade change. At the east end of the bridge, the trail could connect directly to the existing railroad grade.

D. Railroad Agreements

This study is not able to comment to what agency or organization may advocate and convince the railroad to permit this joint use of their facility. There has been successful joint use of railroad bridges in the US, but most railroads have no interest in accepting additional cost, risk, or operational impacts.

E. Bridge Redundancy and Risk Mitigation Strategy

The required redundancy would be provided in the new bridge superstructure.

F. Aesthetic, historical, and viewshed impacts

This alternative has potentially negative aesthetic, historical, or viewshed impacts. The reconstruction of the bridge superstructure could significantly affect bridge aesthetics and the historic fabric depending upon the selected superstructure type. The separation fence between the railroad and the trail will impact the visual aesthetics of the bridge and the viewshed to the north.

Alternative 4: Provide supplemental structure above the existing bridge to provide Freight Rail and Shared Use Trail

This alternative considers that CP Rail continues railroad operation across the bridge and a supplemental structure is added above the existing bridge to provide a new deck level for the shared use trail. This option is only feasible if the railroad can agree to permit the desired use on their right of way.



Figure 8: Concept Graphic of Alternative 4 (Image provided by Dan Cross)

A. Shared Use (Bicycle and Pedestrian) Trail Layout

The supplemental shared use trail bridge deck would be placed above the existing railroad deck to provide the minimum 23.5-ft of vertical clearance required. This alternative assumes a 12-ft wide trail, however the supplemental structure would likely need to be the full width of the existing bridge to facilitate load transfer effectively.

B. Safety

4.5-ft tall metal railings would be provided along the edge of the shared use trail deck for the length of the bridge. As the trail descends from above the railroad off the ends of the bridge, supplemental railroad separation fence would be required.

C. Trail Connectivity

With the shared use trail deck required to be about 27 feet above (accounting for the required structure depth), the connections to the existing grades would need to be addressed. Ramps extending down from this heighten level at each end of the bridge would be required sloping at or below code required maximum grades to touchdown with existing grades. Although this report does not include the cost of such connections, the approach configuration and slope requirements could be significant project costs that should be addressed if this alternative is advanced.

D. Railroad Agreements

This study is not able to comment to what agency or organization may advocate and convince the railroad to permit this joint use of their facility. There has been successful joint use of railroad bridges in the US, but most railroads have no interest in accepting additional cost, risk, or operational impacts.

E. Bridge Redundancy and Risk Mitigation Strategy

To provide redundancy to the bridge, the supplemental structure could be designed to provide the needed redundancy for all bridge loads, or coupled with improvements to the existing bridge redundancy described in Alternative 2A. This study assumes analysis and design costs for the supplemental structure and determination of how to provide a bridge with the overall required redundancy.

F. Aesthetic, historical, and viewshed impacts

Aesthetic and historical impacts could range from minimal to significant depending upon the type of supplemental structure to provide the elevated trail. Complementary structure types could be used to minimize these impacts. Users can experience unimpeded views to the north and south above the safety railing.

A summary of the four alternative considerations is provided in Appendix D, Exhibit D6: Alternative Consideration Summary.

4. ENVIRONMENTAL DOCUMENTATION

The project may require review by the Minnesota Department of Transportation, US Fish and Wildlife Service, National Park Service, Army Corp of Engineers and the Minnesota Natural Resources Commission as part of a NEPA environmental documentation process to achieve necessary approvals for the bridge improvements. The scope of the project and funding sources will determine the required reviews and documentation needed. It is important to understand the required environmental documentation process as this document will explore a no-build alternative and compare build alternatives to the purpose and need of the project.

5. ESTIMATED COSTS FOR ALTERNATIVES

The estimated costs for the proposed improvements described in the alternatives above for Bridge L5733 are detailed below. The estimated costs are based on current costs and will vary based on price escalation and market conditions.

| | <i>Construction Cost Subtotal</i> | <i>Indirect Cost Subtotal</i> | <i>Contingency</i> | Overall Cost |
|--|-----------------------------------|-------------------------------|--------------------|---------------------|
| Alternative 1: Cease Freight Rail Operation, Convert to Shared Use Trail | \$5,000,000 | \$1,100,000 | \$1,300,000 | \$7,400,000 |
| Alternative 2: Rehabilitate Bridge to provide Freight Rail and Shared Use Trail | \$6,800,000 | \$1,400,000 | \$1,700,000 | \$9,900,000 |
| Alternative 3: Partially Reconstruct Bridge to provide Freight Rail and Shared Use Trail | \$19,500,000 | \$3,400,000 | \$4,600,000 | \$27,500,000 |
| Alternative 4: Provide supplemental structure above the existing bridge to provide Freight Rail and Shared Use Trail | \$15,800,000 | \$2,800,000 | \$3,800,000 | \$22,400,000 |

Table 2: Opinion of Probable Costs

Exhibits D1 through D4 in the Appendix provide detailed information regarding the Opinion of Probable Costs used to develop Table.

Indirect Costs

The proposed alternatives identified above are specific analysis, design, and construction tasks with associated costs. As stated, all alternatives will require additional inspection, rating and analysis, design, and construction effort to prepare construction documents describing the work above in detail to allow a contractor bidding process, which is assumed to be required based upon likely public funding. This report has identified certain costs for these items and provided relative costs associated with each task.

Inspection and Load Rating for Pedestrian Load is intended to identify the costs associated with an in-depth bridge inspection of the bridge and load rating of the bridge elements to confirm assumptions that have been made in this report. The in-depth inspection would require a two-person team and equipment to inspect and document the existing geometry, deterioration, and damage to the structure. This information would be used to provide a load rating analysis using the intended pedestrian loads to be carried by the bridge. This load rating analysis would confirm the members needing strengthening, or if a reduction in bridge width is needed to allow existing members to carry the intended loads.

Permitting and Agency Coordination is intended to identify the cost associated with gaining regulatory agency permits and coordination with these agencies to gain approvals for the improvements. These costs do not include any National Environmental Policy Act (NEPA) environmental documentation or approvals.

Design and Plan Preparation is intended to identify the costs associated with designing the alternatives being considered and developing plans for the required improvements for the alternative being considered. This information, along with other specifics of the bridge improvements identified above, would be included in construction documents provided to contractors to solicit bids for the improvement work.

Construction Phase Services is intended to identify the costs associated with construction administration, oversight, and inspections that may be desired or required during construction of the bridge improvements.

The estimated project costs include a 20 percent construction contingency and an allowance for indirect costs such as inspection, engineering and construction administration. All costs in the report are in today's dollars, not including possible escalation in the construction costs.

6. PROJECT SCHEDULE

At the time of the writing of this report, a project schedule has not been developed.

Regarding the construction timeframes needed to complete each alternative, this report cannot speak to construction durations of the proposed improvements. Detailed inspection and analysis as is recommended by this study is needed to identify the specific work activities and durations of the improvements.

7. DISCLAIMER

Kimley-Horn was retained to perform a limited feasibility analysis, and we performed only those tasks specifically stated in our scope of services. The contents of this report are based on visual observations obtained from only the locations observed by the Engineer. There may be variations in materials and environmental conditions from point to point on the structure. It is possible that conditions exist that were not detected by the Engineer's limited visual observations. This report is for the exclusive use of the client. Engineer makes no representations to any other person.

The extent and detail of information is related to the scope of observations and additional information can and should be obtained through more detailed observation or testing. The Owner may consider further observations or testing after receiving this report. If the client obtains additional information subsequent to this report, the Engineer's opinion may no longer be valid without further review of the additional information.

The engineer has no control over the cost of labor, materials, equipment, or over a contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to engineer at this time and represent only the engineer's judgment as a design professional familiar with the construction industry. The engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

Engineer's reports are based on the information gathered and constitute an opinion based on professional judgment. No warranty is made, expressed or implied, that deficiencies that may affect life or safety may not exist.

APPENDIX A
LOCATION MAP



Figure A1: Location Map

**APPENDIX B
SITE PHOTOS**



Exhibit B1: South Elevation of Truss Spans



Exhibit B2: Span 1 over West River Parkway looking South



Exhibit B3: Span 5 over East River Parkway looking North



Exhibit B4: Bridge deck looking west



Exhibit B5: West Abutment and underside of Span 1 looking west



Exhibit B6: West river pier and underside of Span 2 looking east



Exhibit B7: East Abutment looking southeast



Exhibit B8: Typical lower chord pin and eyebar, south face looking east



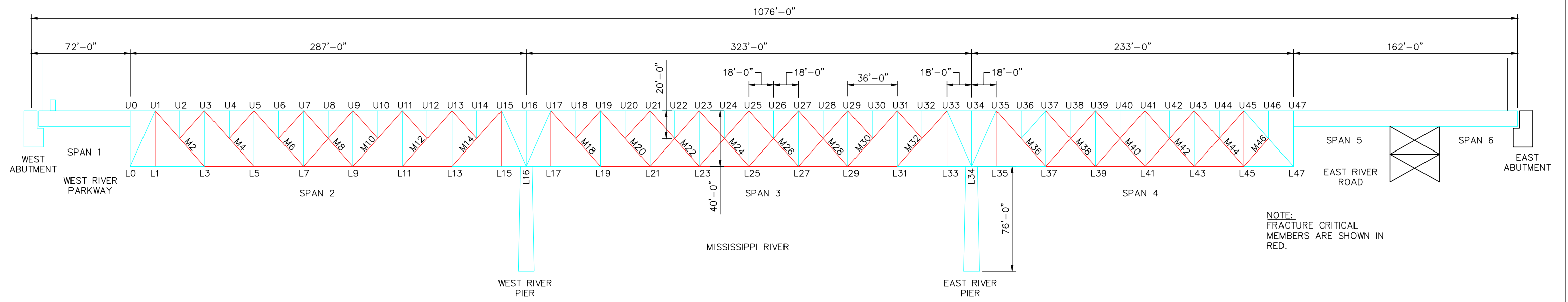
Exhibit B9: Typical pin and eyebar connection, north face looking south east



Exhibit B10: Truss bearing at West river pier, looking east:

APPENDIX C
BRIDGE GEOMETRY

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APPENDIX D
COST & SUMMARY EXHIBITS

Exhibit D1: Pre-design Opinion of Probable Cost
Alternative 1: Cease Freight Rail Operation, Convert to Shared Use Trail

Short Line Bridge - Bridge L5733
 Midtown Greenway Extension across the Mississippi River

Date: 04/12/2019
 Minneapolis, Minnesota

Estimate of Construction Costs

| | Description | Unit | Quantity | Unit Price | Extension | Comments |
|-----------------------------------|---|-----------|----------|-------------|--------------------|--|
| 1 | Mobilization | Lump Sum | 1 | \$250,000 | \$250,000 | Mobilize equipment to site, assume 5% of total construction cost. |
| 2 | 12-ft wide aluminum decking | Sq. Feet | 13,000 | \$150 | \$1,950,000 | Trail decking and support structure to existing truss. |
| 3 | Edge Protection Railing | Lin. Feet | 2,200 | \$175 | \$385,000 | Galvanized steel 4.5-ft tall fence and anchorages both sides of trail. |
| 4 | Bridge Trail Lighting | Lump Sum | 1 | \$100,000 | \$100,000 | Light poles, conduit, conductors, service panels. |
| 5 | Structural Repairs to Existing Truss | Lump Sum | 1 | \$485,000 | \$485,000 | Repairs to existing truss, assumed \$15 per sq. foot of bridge. |
| 6 | Provide Structural Redundancy for Truss | Lump Sum | 1 | \$1,750,000 | \$1,750,000 | Improvements to provide redundancy, assumed \$50 per sq. foot of bridge. |
| Construction Cost Subtotal | | | | | \$5,000,000 | |

Estimate of Indirect Costs

| | Description | Lump Sum | % of Construction Cost | Extension | Comments |
|-------------------------------|--|----------|------------------------|--------------------|---|
| 1 | Inspection and Load Rating for Pedestrian Load | Lump Sum | | \$150,000 | Hands on Bridge Inspection and Structural Analysis. |
| 2 | Design and Plan Preparation | | 8% | \$400,000 | Preparation of Improvement Plans for Bidding. |
| 3 | Permitting and Agency Coordination | Lump Sum | | \$100,000 | Review Process (Corp of Engineers, USFWS, MnDNR, etc.). |
| 4 | Construction Phase Services | | 8% | \$400,000 | Management and Oversight during construction. |
| Indirect Cost Subtotal | | | | \$1,100,000 | |
| Contingency | | | 20% | \$1,300,000 | Unforeseen conditions (% of total construction and indirect costs). |

Overall Cost

\$7,400,000

Assumptions:

Railroad property access or acquisition costs are not included.
 Off bridge trail costs are not included.
 Bridge painting is not included.

Exhibit D2: Pre-design Opinion of Probable Cost

Alternative 2: Rehabilitate Bridge to provide Freight Rail and Shared Use Trail

Short Line Bridge - Bridge L5733

Midtown Greenway Extension across the Mississippi River

Date: 04/12/2019

Minneapolis, Minnesota

Estimate of Construction Costs

| | Description | Unit | Quantity | Unit Price | Extension | Comments |
|-----------------------------------|---|-----------|----------|-------------|--------------------|---|
| 1 | Mobilization | Lump Sum | 1 | \$350,000 | \$350,000 | Mobilize equipment to site, assume 5% of total construction cost. |
| 2 | 12-ft wide aluminum decking | Sq. Feet | 13,000 | \$150 | \$1,950,000 | Trail decking and support structure to existing truss. |
| 3 | Railroad Separation Railing | Lin. Feet | 1,100 | \$250 | \$275,000 | Galvanized steel 10-ft tall fence and anchorages. |
| 4 | Edge Protection Railing | Lin. Feet | 1,100 | \$175 | \$192,500 | Galvanized steel 4.5-ft tall fence and anchorages. |
| 5 | Bridge Trail Lighting | Lump Sum | 1 | \$100,000 | \$100,000 | Light poles, conduit, conductors, service panels. |
| 6 | Structural Repairs to Existing Truss | Lump Sum | 1 | \$650,000 | \$650,000 | Repairs to existing truss, assumed \$20 per sq. foot of bridge. |
| 7 | Provide Structural Redundancy for Truss | Lump Sum | 1 | \$3,250,000 | \$3,250,000 | Improvements to provide redundancy, assumed \$100 per sq. foot of bridge. |
| Construction Cost Subtotal | | | | | \$6,800,000 | |

Estimate of Indirect Costs

| | Description | Lump Sum | % of Construction Cost | Extension | Comments | |
|-------------------------------|--|----------|------------------------|--------------------|---|--|
| 1 | Inspection and Load Rating for Pedestrian Load | Lump Sum | | \$150,000 | Hands on Bridge Inspection and Structural Analysis. | |
| 2 | Design and Plan Preparation | | 8% | \$544,000 | Preparation of Improvement Plans for Bidding. | |
| 3 | Permitting and Agency Coordination | Lump Sum | | \$100,000 | Review Process (Corp of Engineers, USFWS, MnDNR, etc.). | |
| 4 | Construction Phase Services | | 8% | \$544,000 | Management and Oversight during construction. | |
| Indirect Cost Subtotal | | | | \$1,400,000 | | |
| Contingency | | | | 20% | \$1,700,000 | Unforeseen conditions (% of total construction and indirect costs). |
| Overall Cost | | | | | \$9,900,000 | Assumptions: Railroad property access or acquisition costs are not included. Off bridge trail costs are not included. Bridge painting is not included. |

Exhibit D3: Pre-design Opinion of Probable Cost

Alternative 3: Partially Reconstruct Bridge to provide Freight Rail and Shared Use Trail

Short Line Bridge - Bridge L5733

Midtown Greenway Extension across the Mississippi River

Date: 04/12/2019

Minneapolis, Minnesota

Estimate of Construction Costs

| | Description | Unit | Quantity | Unit Price | Extension | Comments |
|-----------------------------------|-----------------------------|-----------|----------|--------------|---------------------|--|
| 1 | Mobilization | Lump Sum | 1 | \$900,000 | \$900,000 | Mobilize equipment to site, assume 5% of total construction cost. |
| 2 | New Bridge Superstructure | Lump Sum | 1 | \$16,000,000 | \$16,000,000 | New redundant truss superstructure, assume \$500 per sq. foot of bridge. |
| 3 | 12-ft wide aluminum decking | Sq. Feet | 13,000 | \$150 | \$1,950,000 | Trail decking. |
| 4 | Railroad Separation Railing | Lin. Feet | 1,100 | \$250 | \$275,000 | Galvanized steel 10-ft tall fence and anchorages. |
| 5 | Edge Protection Railing | Lin. Feet | 1,100 | \$175 | \$192,500 | Galvanized steel 4.5-ft tall fence and anchorages. |
| 6 | Bridge Trail Lighting | Lump Sum | 1 | \$100,000 | \$100,000 | Light poles, conduit, conductors, service panels. |
| Construction Cost Subtotal | | | | | \$19,500,000 | |

Estimate of Indirect Costs

| | Description | Lump Sum | % of Construction Cost | Extension | Comments |
|-------------------------------|--|----------|------------------------|---------------------|---|
| 1 | Inspection and Load Rating for Pedestrian Load | Lump Sum | | \$150,000 | Hands on Bridge Inspection and Structural Analysis. |
| 2 | Design and Plan Preparation | | 8% | \$1,560,000 | Preparation of Improvement Plans for Bidding. |
| 3 | Permitting and Agency Coordination | Lump Sum | | \$100,000 | Review Process (Corp of Engineers, USFWS, MnDNR, etc.). |
| 4 | Construction Phase Services | | 8% | \$1,560,000 | Management and Oversight during construction. |
| Indirect Cost Subtotal | | | | \$3,400,000 | |
| Contingency | | | 20% | \$4,600,000 | Unforeseen conditions (% of total construction and indirect costs). |
| Overall Cost | | | | \$27,500,000 | Assumptions: |

Railroad property access or acquisition costs are not included.
 New railroad track is not included.
 Bridge substructures can sustain new superstructure.
 Off bridge trail costs are not included.
 Bridge painting is not included.

Exhibit D4: Pre-design Opinion of Probable Cost

Alternative 4: Provide supplemental structure above the existing bridge to provide Freight Rail and Shared Use Trail

Short Line Bridge - Bridge L5733

Date: 04/12/2019

Midtown Greenway Extension across the Mississippi River

Minneapolis, Minnesota

Estimate of Construction Costs

| | Description | Unit | Quantity | Unit Price | Extension | Comments |
|-----------------------------------|---|-----------|----------|-------------|---------------------|---|
| 1 | Mobilization | Lump Sum | 1 | \$800,000 | \$800,000 | Mobilize equipment to site, assume 5% of total construction cost. |
| 2 | Supplemental Support for Trail above Railroad | Lump Sum | 1 | \$4,850,000 | \$4,850,000 | New deck level for trail, assumed \$150 per sq. foot of bridge. |
| 3 | 12-ft wide aluminum decking | Sq. Feet | 13,000 | \$150 | \$1,950,000 | Trail decking and support structure to supplemental support. |
| 4 | Edge Protection Railing | Lin. Feet | 2,200 | \$175 | \$385,000 | Galvanized steel 4.5-ft tall fence and anchorages, both sides of trail. |
| 5 | Bridge Trail Lighting | Lump Sum | 1 | \$100,000 | \$100,000 | Light poles, conduit, conductors, service panels. |
| 6 | Approach Ramp Structure | Lump Sum | 1 | \$3,750,000 | \$3,750,000 | Assumes 540-ft-long access ramp, 5% max. grade, adjacent to railroad. |
| 7 | Structural Repairs to Existing Truss | Lump Sum | 1 | \$650,000 | \$650,000 | Repairs to existing truss, assumed \$20 per sq. foot of bridge. |
| 8 | Provide Structural Redundancy for Truss | Lump Sum | 1 | \$3,250,000 | \$3,250,000 | Improvements to provide redundancy, assumed \$100 per sq. foot of bridge. |
| Construction Cost Subtotal | | | | | \$15,800,000 | |

Estimate of Indirect Costs

| | Description | Lump Sum | % of Construction Cost | Extension | Comments |
|-------------------------------|--|----------|------------------------|--------------------|---|
| 1 | Inspection and Load Rating for Pedestrian Load | Lump Sum | | \$150,000 | Hands on Bridge Inspection and Structural Analysis. |
| 2 | Design and Plan Preparation | | 8% | \$1,264,000 | Preparation of Improvement Plans for Bidding. |
| 3 | Permitting and Agency Coordination | Lump Sum | | \$100,000 | Review Process (Corp of Engineers, USFWS, MnDNR, etc.). |
| 4 | Construction Phase Services | | 8% | \$1,264,000 | Management and Oversight during construction. |
| Indirect Cost Subtotal | | | | \$2,800,000 | |

Contingency

20%

\$3,800,000

Unforeseen conditions (% of total construction and indirect costs).

Overall Cost

\$22,400,000

Assumptions:

Railroad property access or acquisition costs are not included.
Off bridge trail costs are not included, except the access ramp structure.
Bridge painting is not included.

Exhibit D5: Pre-design Opinion of Probable Cost Summary

Short Line Bridge - Bridge L5733

Midtown Greenway Extension across the Mississippi River

Date: 04/12/2019

Minneapolis, Minnesota

| | <i>Construction Cost Subtotal</i> | <i>Indirect Cost Subtotal</i> | <i>Contingency</i> | <i>Overall Cost</i> |
|--|---------------------------------------|-----------------------------------|--------------------|----------------------------|
| Alternative 1: Cease Freight Rail Operation, Convert to Shared Use Trail | \$5,000,000 | \$1,100,000 | \$1,300,000 | \$7,400,000 |
| Alternative 2: Rehabilitate Bridge to provide Freight Rail and Shared Use Trail | \$6,800,000 | \$1,400,000 | \$1,700,000 | \$9,900,000 |
| Alternative 3: Partially Reconstruct Bridge to provide Freight Rail and Shared Use Trail | \$19,500,000 | \$3,400,000 | \$4,600,000 | \$27,500,000 |
| Alternative 4: Provide supplemental structure above the existing bridge to provide Freight Rail and Shared Use Trail | \$15,800,000 | \$2,800,000 | \$3,800,000 | \$22,400,000 |

Exhibit D6: Alternative Consideration Summary

Short Line Bridge - Bridge L5733
Midtown Greenway Extension across the Mississippi River

Date: 04/12/2019
Minneapolis, Minnesota

| | <i>Trail Layout</i> | <i>Safety</i> | <i>Trail Connectivity</i> | <i>Railroad Agreements</i> | <i>Redundancy</i> | <i>Aesthetic Impacts</i> | <i>Historical Impacts</i> | <i>Viewshed Impacts</i> |
|--|---|--|---|--|---|--|--|--|
| Alternative 1: Cease Freight Rail Operation, Convert to Shared Use Trail | Trail centered on existing bridge | 4.5-ft railings each side of trail | Direct connection to existing Greenway & railroad grade | Need to acquire railroad right-of-way or use agreement | Bridge redundancy improvements provided | None | None | None |
| Alternative 2: Rehabilitate Bridge to provide Freight Rail and Shared Use Trail | Trail adjacent existing freight railroad on existing bridge | 10-ft fence on north side of trail, 4.5-ft fence on south side | Direct connection to existing Greenway & railroad grade | Need to acquire railroad right-of-way or use agreement | Bridge redundancy improvements provided | Railroad separation fence will impact aesthetics | None | Railroad separation fence will impact north viewshed |
| Alternative 3: Partially Reconstruct Bridge to provide Freight Rail and Shared Use Trail | Trail adjacent existing freight railroad on new bridge superstructure | 10-ft fence on north side of trail, 4.5-ft fence on south side | Direct connection to existing Greenway & railroad grade | Need to acquire railroad right-of-way or use agreement | Bridge redundancy improvements provided | Railroad separation fence will impact aesthetics | None | Railroad separation fence will impact north viewshed |
| Alternative 4: Provide supplemental structure above the existing bridge to provide Freight Rail and Shared Use Trail | Trail above existing freight railroad on supplemental bridge superstructure | 4.5-ft railings each side of trail | Significant ramps (~540-ft long) required at each end of the bridge | Need to acquire railroad right-of-way or use agreement | Bridge redundancy improvements provided | Potential impacts depending on supplemental structure type | Potential impacts depending on supplemental structure type | None |