Existing and Projected Conditions Report

Swan River – Bridge St (Bigfork)

STPB 9015 (126)

UPN 9020000

July, 2016

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ABBREVIATIONS / ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
BLUAC	Bigfork Land Use Advisory Committee
COS	Certificate of Survey
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
LOS	Level of Service
LRFD	Load and Resistance Factor Design
MDT	Montana Department of Transportation
MBE	Manual for Bridge Evaluation
NRHP	National Register of Historical Places
PROWAG	Public Rights-of-Way Accessibilities Guidelines
R/W	Right of Way
Swan River	Swan River - Bridge St (Bigfork)
Vph	Vehicles per hour

1 INTRODUCTION

Flathead County requested Montana Department of Transportation (MDT) assistance in reviewing the feasibility of rehabilitating or replacing of the Swan River Bridge, a single-lane truss bridge constructed in 1911-12. The 119 – foot long bridge rests atop concrete abutments and has a narrow pedestrian walkway hung outside the east truss. The bridge crosses the Swan River in Bigfork Montana approximately 0.2 miles east of State Primary Route 35 (MT 35). Listed on the National Register of Historic Places (NRHP) in 2015, this bridge provides one of two river crossings between the Bigfork Dam and Flathead Lake. The bridge is load-limited due to corrosion and damage to the century-old steel truss. The historic appearance of the bridge is a valued component to the business and tourist community of Bigfork, which is an unincorporated village in Flathead County. The bridge is maintained by and under the jurisdiction of Flathead County.

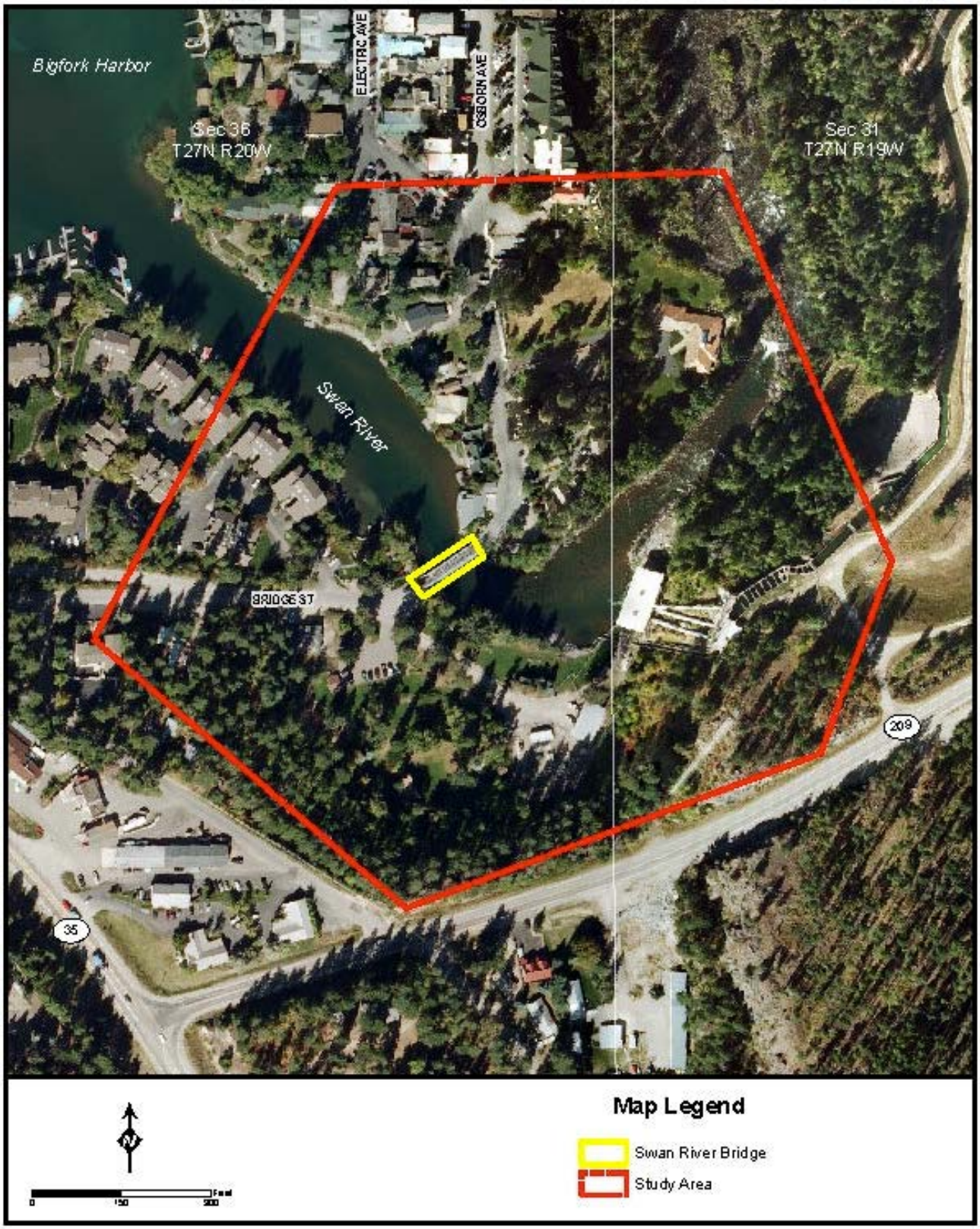
The Existing and Projected Conditions report is a planning level analysis aimed at identifying bridge features and the adjoining physical, environmental, social and cultural characteristics to help identify issues, constraints and opportunities for rehabilitation or replacement of the bridge to maintain its transportation function within the study area. This study does not assess significant realignment of the existing structure or significant shifting of the approach roadways.

1.1 Study Area

Figure 1 shows the greater Bigfork community, at the northeastern edge of Flathead Lake. **Figure 2** illustrates the study area which focuses narrowly around the existing bridge and its roadway approaches. Because this study is only considering options to rehabilitate or replace the existing bridge, the study area is limited to issues associated with the function of the bridge and its approaches.

Figure 1: Vicinity Map

Figure 2: Swan River Bridge Study Area



2 BRIDGE SYSTEM

Physical features and characteristics of the study area were identified through field observations, completed bridge reports, review of published statistics, GIS data and information provided by the MDT Bridge Bureau.

Appendix 1 contains a photo log documenting conditions observed during the 2015 bridge inspection.

2.1 Bridge Design Standards

The Swan River Bridge was designed and built prior to the adoption or enforcement of design standards, prior even to creation of Montana's Highway Commission or Department.

For the purposes of this study, MDT and Flathead County have recognized that, due to the historical nature and the unique features of the bridge within Bigfork, future options may not need to meet current design standards. Application of design standards will be addressed in a separate report for the bridge needs. Current design standards are discussed below.

MDT has adopted the 2004 Montana Structures Manual[1] and the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications[2] as the standards for structural bridge design. Flathead County utilizes the most current standard design of the Montana Public Works Standards[3] and AASHTO Road Design Guidelines.[4]

The MDT Structure Manual[5] recognizes the unique nature of the state's historic and truss bridges and provides the following special consideration for these unique structures:

- Provide capacity for HS 15 loading (less than new bridge)
- Provide a minimum 14-foot vertical clearance
- Provide a 16-foot roadway width (for one-lane bridge)

2.1.1 Bridge Load Rating

When a bridge is load rated, each part of the bridge is analyzed and assigned a numerical load rating value based on the ratio of the available capacity of that part divided by the vehicular load it will receive. Bridge members with a load rating factor of 1.0 or higher are adequate to support the given vehicular load. If the rating factor falls below 1.0 for a stated specified vehicular load, then the bridge requires a reduction in the allowable size of vehicle that can cross the bridge. The minimum allowable load limit for a bridge prior to closure is three tons[6].

[1] Montana Structures Manual, MDT, 2004.
[2] LRFD Bridge Design Specifications 7th Edition, AASHTO, 2014.
[3] Montana Public Works Standards and Specifications, Montana Contractors Association, 2010.
[4] A Policy on Geometric Design of Highways and Streets, AASHTO, 2011.
[5] MDT Structures Manual, MDT, 2004.
[6] AASHTO Manual for Bridge Evaluation – 2nd Edition (6A.8.1), AASHTO, 2014 Interim Revisions.

The 2014 load rating factor of the bridge is 0.05[7] with a posted load limit restricted to three tons, in accordance with the AASHTO[8] and MDT[9] requirements.

2.1.2 Seismic and Hydraulic Considerations

No seismic analysis has been carried out for this bridge. Due to its age, the structure is unlikely to be compliant with modern seismic codes.

Although scour does not appear to be a problem at the bridge abutments, no scour analysis has been performed at the bridge site. No hydraulic analysis of the Swan River at the bridge has been performed outside the Federal Emergency Management Association (FEMA[10]) flood insurance study.

2.2 Existing Records

There are no known original drawings or records from the construction of the bridge or the addition of the walkway. The only recorded bridge drawings are on file in the MDT Bridge Bureau, and contain information and measurements gathered by MDT personnel or consultant bridge inspectors in recent years.

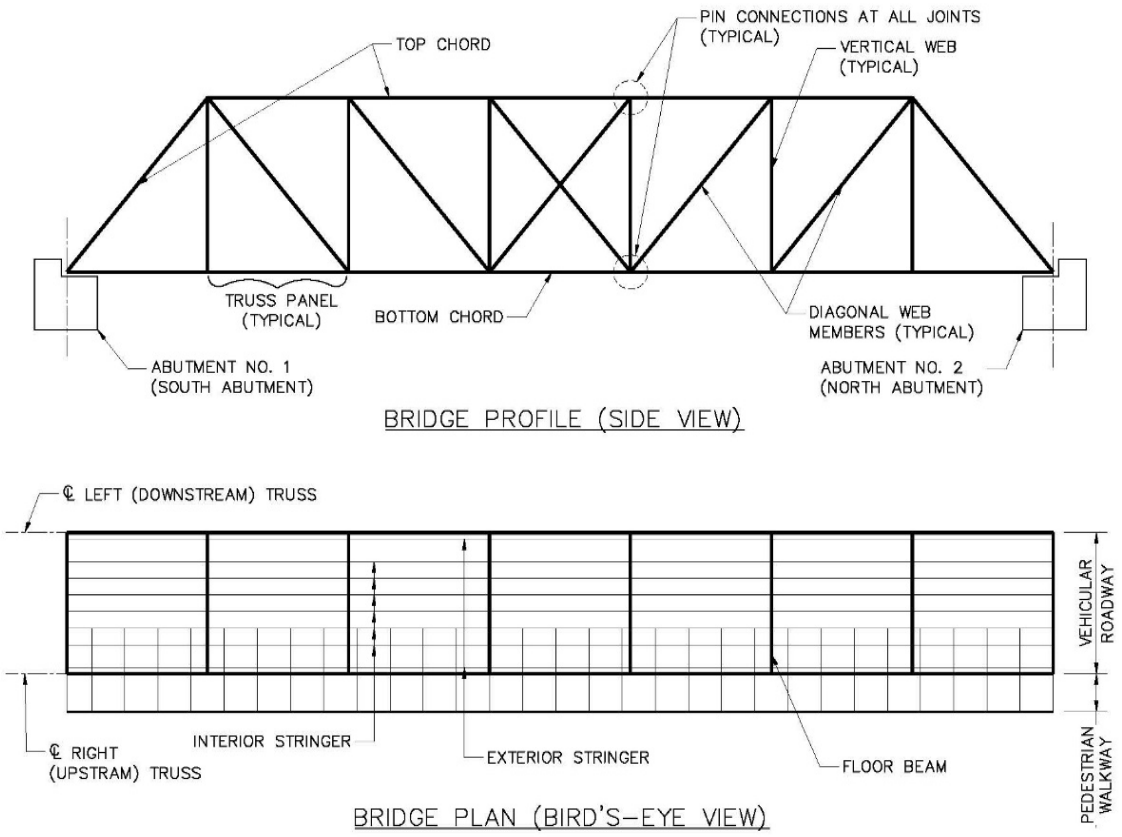
[7] Bridge Loading Rating Report for Swan River Bridge # L15672000+02001, KLJ, 2014.
[8] AASHTO Manual for Bridge Evaluation – 2nd Edition, AASHTO, 2014 Interim Revisions.
[9] MDT Bridge Inspection and Rating Manual, MDT, 2013.
[10] Flood Insurance Study – Flathead County Montana Vol 2, FEMA, 2015.

2.3 Existing Bridge Conditions

2.3.1 Existing Bridge Description

The existing 119-foot, steel truss is a pin connected Pratt through truss. Shown in **Figure 3**, a pedestrian walkway was attached onto the bridge at an unknown date after the original construction. Wooden planks serve as both the driving and walking surfaces.

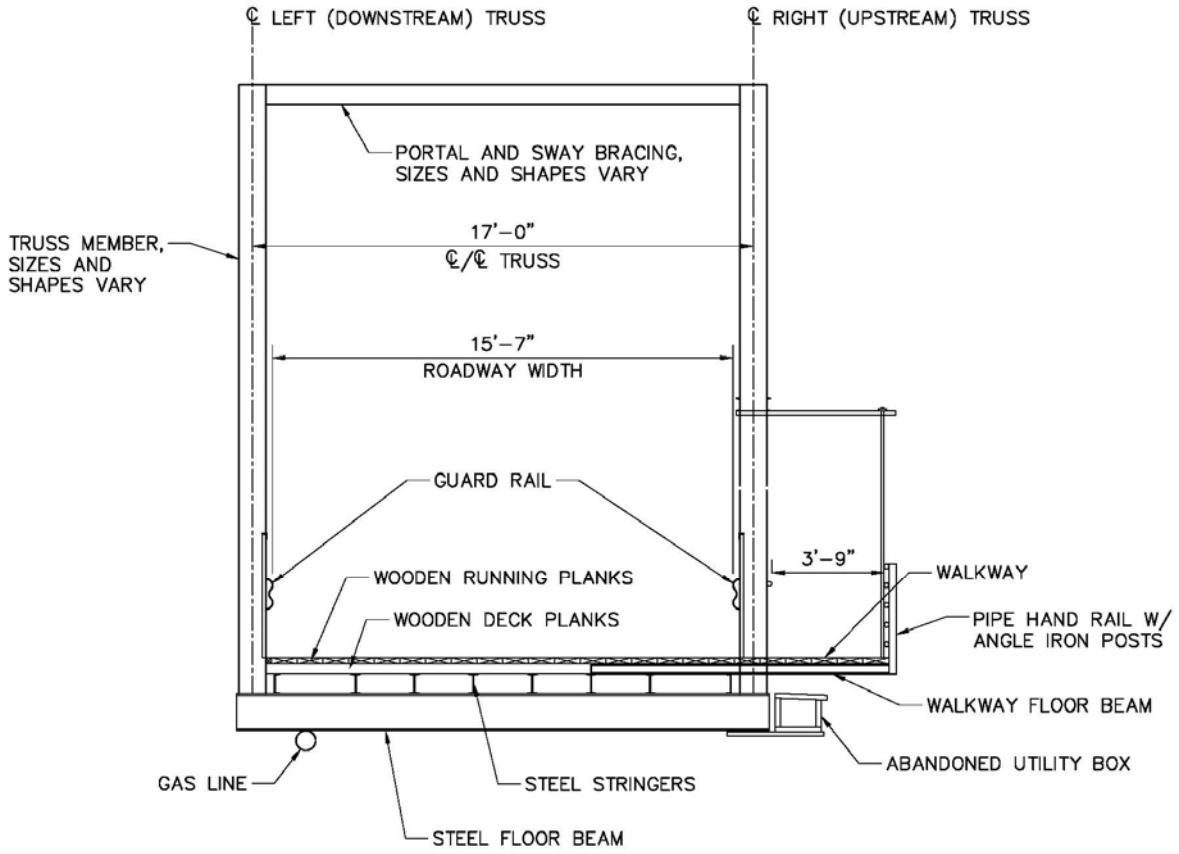
Figure 3: Bridge Plan and Profile



The bridge sits on concrete abutments with unknown foundations. The south abutment appears to rest on bedrock while the north abutment is believed to rest on native soil.

Figure 4 shows the existing bridge cross-section which provides a single 15'-7" vehicle lane with a 16'-2" vertical clearance to the overhead truss and an 8'-6" clearance to a rub-bar installed by the County. The pedestrian walkway provides a 3'-9" width for travel on the upstream side of the bridge. Guardrail (steel W-beam) is installed on both trusses to channel errant vehicles and provides modest protection for the truss members. A detailed description of the individual truss elements is included in **Appendix 2**.

Figure 4: Bridge Cross Section



County staff have installed hanging rub-bars at both ends of the bridge (shown right) to provide a visual deterrent to drivers of large vehicles. The 8'-6" rub-bar height is well below the clearance of the truss. The structure itself provides adequate clearance for most vehicles, although the rub-bar does not provide vertical clearance for taller vehicles. Observations indicate the rub-bar is impacted regularly; but due to its swinging nature no bridge or vehicular damage is typically incurred.

2.3.2 Existing Structure Conditions

This section summarizes the extensive structural deficiencies observed in various inspections and analyses. [11,12,13] Also refer to **Appendix 3** for a detailed list describing the structural deficiencies of the Swan River Bridge.

The steel truss members all have varying degrees of corrosion which reduces their effective size, thus reducing their ability to carry loads. The most severely corroded components of the bridge are the steel stringers, floorbeams, and pins at the bearings (shown left).

At some point during the life of the truss, an errant vehicle struck the left side of the truss causing substantial damage to the vertical web member VW3-L and minor damage to the diagonal web member DW4-L. The vehicular damage was repaired by welding.

The concrete abutments have minor spalling and abrasion loss but no major cracks have been observed.

[11] Bridge Loading Rating Report for Swan River Bridge # L15672000+02001, KLJ, 2014.
[12] MDT Initial Assessment (bi-annual bridge safety inspection), MDT, 2015.
[13] Conditions Evaluation Report: Big Fork Bridge # L156720100-02001, Fish & Associates, Inc., 2015.

The capacity of the wood deck planks is reduced due to the presence of moisture, substantiated by observations of fungal growth.

The pedestrian walkway is narrow and does not meet Americans with Disability Act (ADA) requirements for accessibility. The wooden surface and the pipe hand rail also do not meet current design standards.

2.3.3 Fracture Critical Configuration

The term fracture critical for a bridge structure is defined as:

> "A fracture critical member is a metal structural component, typically a superstructure tension or bending member, which would cause collapse of the structure or span if it fails.[14]"

Fracture critical bridge designs are discouraged in modern engineering practice because of a lack of redundant or alternate load paths. The Swan River truss is a fracture critical structure.

There are two different categories of fracture critical members for the Swan River truss bridge. First are the steel truss components (i.e. pins, eye-bars, bottom chords, and the vertical and diagonal web members), and second are the transverse steel girders (i.e. floor beams). Full or partial collapse of the entire structure could result from the failure of one of these member types.

[14] Montana Structures Manual (Volume 2, Chapter 22.3.4.2), MDT, 2004.

2.4 Critical/Controlling Components

All results presented in this section are from the 2014 bridge load rating report[15], which in accordance with MDT standard procedure, only analyzed certain portions of the bridge. Elements outside the load rating include:

- Superstructure members outside the vehicular load path (e.g., lateral and sway braces)
- The substructure (e.g., concrete abutments or foundations)
- The walkway

The controlling (or weakest) member of the bridge is the exterior stringer on the right (upstream) side of the bridge with a load rating factor of 0.05. This member controls because of corrosion (holes rusted completely through the beam) and the unbalanced addition of the pedestrian walkway. The exterior stringers were not originally designed to support the loads created by the weight from an offset walkway. Refer to **Appendix 1** for photographs of these areas.

Another factor that exacerbates the low load rating of the stringers is minor twisting. Since the stringers are twisting, the deck does not provide desired stability to the stringers. Consequently the strength of the stringers is further reduced.

The floor beams have the next lowest load rating with an inventory rating factor of 0.288. The controlling truss members were the vertical web members at each end of the bridge with an inventory load rating of 0.431. The wooden deck had an inventory rating factor of 0.618.

2.5 Bridge Maintenance

Visits to the bridge[16] and MDT inspection records[17] show that the connections at the floor beams and the bridge bearings consistently accumulate dirt and debris. This dirt and debris retains moisture which creates ideal conditions for corrosion. Given the bridge's current condition, consistent and frequent cleaning of the affected components will be necessary to slow the rate of deterioration over the next 20 years. Currently, the county only cleans the bridge once per year and the truss portions are not painted on a regular schedule[18].

Snow plowing is required for safe traffic operations but cause deterioration on the wooden running planks. Because salt contributes to the steel corrosion[19], Flathead County discontinued its use of salt on the bridge for ice control. The bridge load limits restrict plowing to a light-weight vehicle (not standard county snow plow). The narrow walkway also restricts the use of motorized units and requires manual shoveling to clear the walkway.

The rate of corrosion of steel components is expected to remain constant. It is projected that another coat of paint will be required on the truss within the next 20 years.

[15] Bridge Loading Rating Report for Swan River Bridge # L15672000+02001, KLJ, 2014.
[16] Bridge Loading Rating Report for Swan River Bridge # L15672000+02001, KLJ, 2014…
[17] MDT Initial Assessment (Bi-annual Bridge Safety Inspection), MDT 2015.
[18] Conversations with Flathead County Road & Bridge personnel, April 2016.
[19] Conversations with Flathead County Road & Bridge personnel, April 2016.

2.6 Projected Bridge Conditions

For the bridge to continue to safely carry vehicles into the future, rehabilitative actions would need to occur beyond the routine maintenance typically performed by Flathead County crews (i.e., cleaning, painting, and replacing deteriorated wooden deck pieces). Damaged and corroded bridge components that will require substantial repair or full replacement include, but are not limited to:

- truss pins,
- bearing assemblies,
- bottom chord members,
- exterior stringers,
- floor beam hangers,
- floor beams,
- bottom lateral bracing, and
- members with substantial vehicular damage.

Other rehabilitative options such as modifying the configuration of the roadway or adding bracing may also be considered. Although a modest increase in the number of vehicles using the bridge is not expected in the near future (see Section 3.5), the current load rating restricts all but the lightest vehicle. Observations note that heavier vehicles (exceeding load limit) currently use the bridge and this is expected to continue.

2.6.1 Future Outlook

Given the current rate of corrosion and the high levels of existing deterioration of the steel components, the Swan River Bridge is expected fall below the minimum-allowable three ton limit which would require closure to vehicular traffic in the relatively near term. A finite time is not projected but pending closure would be based upon (regular) inspections and analysis.

This bridge will not be in continued service in with only the current maintenance plan and with no rehabilitation work. To reach a reasonable expectancy of continued service, rehabilitation will need to occur.

3 NON-BRIDGE SYSTEMS

3.1 Roadway System and Functional Classification

Bridge Street and all streets within the project study area are functionally classified as rural local roads within Flathead County. State Primary Route 35 (MT 35), the primary route along the east side of Flathead Lake is classified as a minor arterial.

Local roads, such as Bridge Street, primarily serve to provide access to adjacent land uses and travel over short distances.

The Bridge Street approaches to the bridge begin as two-lane, paved roads with intermittent sidewalk and curb facilities which narrow onto the single-lane bridge. The bridge has only provided a single-lane width since its construction.

No public transit services exist in the local area. Bigfork Schools provide school bussing but do not utilize the Swan River Bridge as a route. Alternate routes from MT 35 better serve the school campus by avoiding both the narrow downtown streets and the narrow, one-lane Swan River Bridge.

3.2 Right-of-Way and Jurisdiction

Bridge Street, approaching the Swan River Bridge, is a 60-foot wide public right-of-way (R/W) and the bridge is located in the center of the Bridge Street R/W. Both Bridge Street and the Swan River Bridge are under the jurisdiction of Flathead County. Typical with historical locations, documentation suggests varying ownership conditions of the surrounding roadways.

South of the Swan River, the R/W was created by a county road petition in 1904 and is public easement. This is consistent among the ownership documents.

North of the Swan River, the R/W was created by the Plat of Bigfork in 1901. A subsequent series of Certificate of Surveys (COS) muddle ownership between easement (typical for a county) or a fee title. These differences mean some COS show the land is owned to the center of Bridge Street with a public easement while others show the land is only owned to the edge of the R/W. **Appendix 4** provides a summary of the ownership documents and their distinctions. The uncertainty of Bridge Street legal status (fee title or easement) does not limit the use of the existing R/W to the public.

Changes or modifications can be made to Bridge Street and the bridge within the 60-foot county easement area. However if construction activities extend outside the 60-foot easement, R/W negotiations will be required for either temporary access (during construction) or for permanent access. The north side of the bridge is expected to require more effort to obtain such access due to its complex legal ownership.

3.3 Utilities

An 8" natural gas, cast iron pipe and an abandoned utility box hang underneath the Swan River Bridge. Overhead utility lines run along the east (upstream) side of Swan River Bridge. No other utilities are contained within the bridge structure.

Existing utility poles located near the northeast and southeast bridge corners may conflict with changes to the approach or the walkway or the bridge itself. The northeast pole also provides overhead lighting for the north approach to the bridge

The Bigfork area recently completed storm sewer improvements which discharge into underground concrete vaults (manholes) on both sides of the bridge. These two concrete vaults allow contaminates to discharge prior to storm water flowing into the river. The curb, underground pipes and concrete vaults represent a significant investment by the community to meet water quality requirements. Bridge options will need to consider these infrastructure improvements.

3.4 Crash Analysis

A total of three crashes were reported on Bridge Street during the ten-year analysis period from January 1, 2005 to December 31, 2014. None of the crashes occurred on the Swan River Bridge. One right-angle crash involved a parked car and two crashes involved backing vehicles. All crashes reported property damage only (no injuries) and there were no pedestrians/bicycles involved.

Two of the crashes occurred during cloudy daylight with snow and dry road conditions. One crash occurred during clear dark-lighted with dry road conditions. There were no correctable crash trends identified based on the reported information.

The one-lane bridge operations have not reported any crashes in the past ten years. It is noted that the one-lane operations appear to work acceptably for this area and is a strongly-desired condition based upon local comments. Local opinion indicates that the single-lane bridge dictates slower travel speeds, which are beneficial to the tight road curvature approaching the bridge and the narrow downtown streets.

3.5 Vehicular and Pedestrian Operations

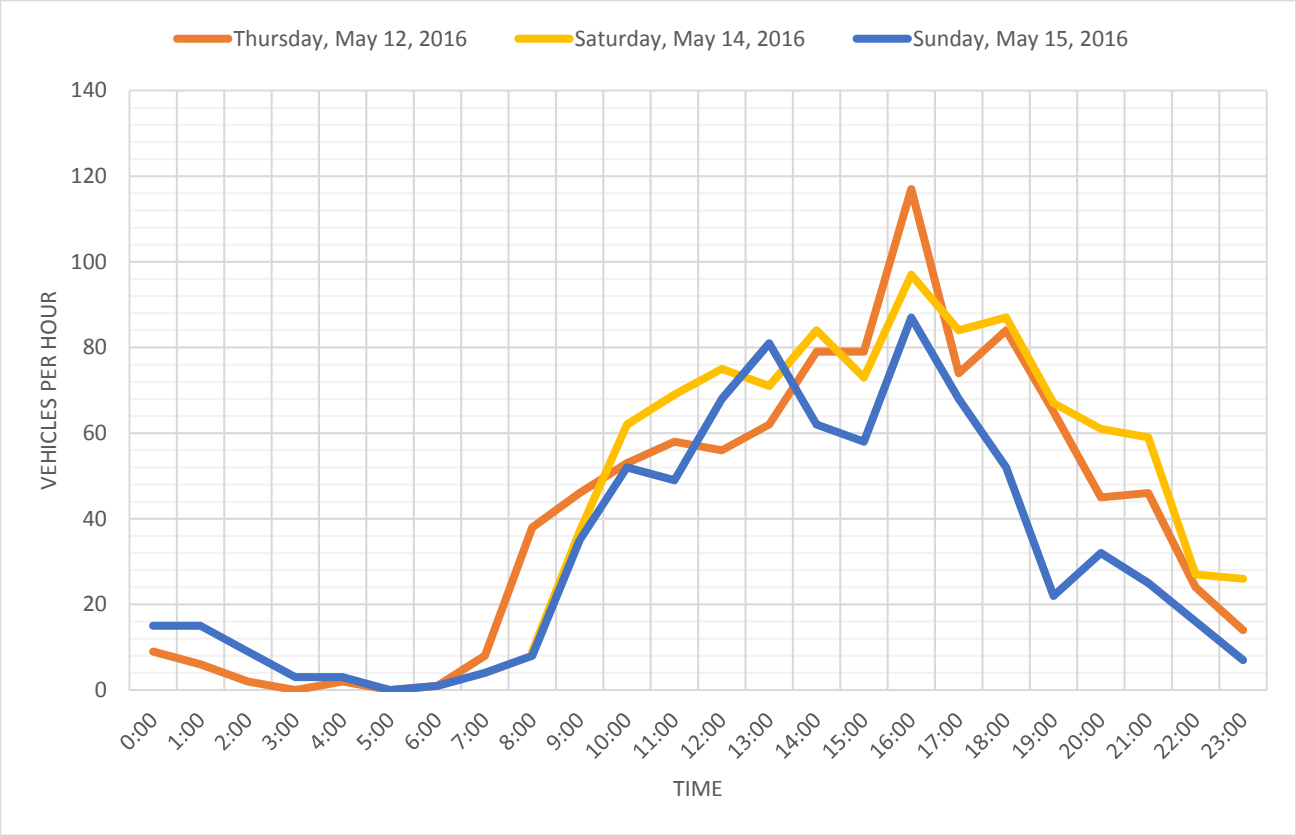
3.5.1 Vehicular Volumes

Average Daily Traffic (ADT) is the total of all motorized vehicles traveling in both directions on a roadway on an average day.

As part of the study, video traffic counts were obtained during May 2016[20]. Based upon the 2016 counts, the Swan River Bridge carried 1,035 vehicles per day (average) with the highest counts observed on Saturday. No large trucks were observed using the bridge. However, campers and trailers were observed hitting the rub-bar. Due to the one-lane bridge, hourly vehicles represent the local need (rather than the daily volumes). **Figure 5** shows the May 2016 hourly volumes for vehicles crossing the Swan River Bridge (actual volumes not adjusted for yearly average).

[20] Video Traffic Observations, KLJ, May 2016.

Figure 5: Hourly Traffic Volumes – May 2016



Flathead County recorded an ADT of 2,953 vehicles north of the Swan River Bridge in July 2012, which represented the high season peak during the summer tourism months.

The peak hour for traffic on Swan River Bridge for Thursday, Saturday and Sunday all occurred during the hour of 4:00 pm and 5:00 pm, with counts ranging 97 to 117 vehicles per hour (mph), an average of less than two vehicles per minute. Vehicle queues to enter the single lane bridge did not extend more than three vehicles during the 2016 counts which appear to be representative of off-season traffic.

Due to the one-lane bridge and the nature of Bigfork, population and business growth is not anticipated in the vicinity of the bridge that would result in a notable increase in traffic. The project needs are geared toward maintaining a river crossing – not towards increasing vehicle capacity. Therefore, no traffic projections were prepared as part of this report. Furthermore, the single-lane layout of the bridge, if maintained, will continue to deter non-local traffic from using Bridge Street as a travel route of choice.

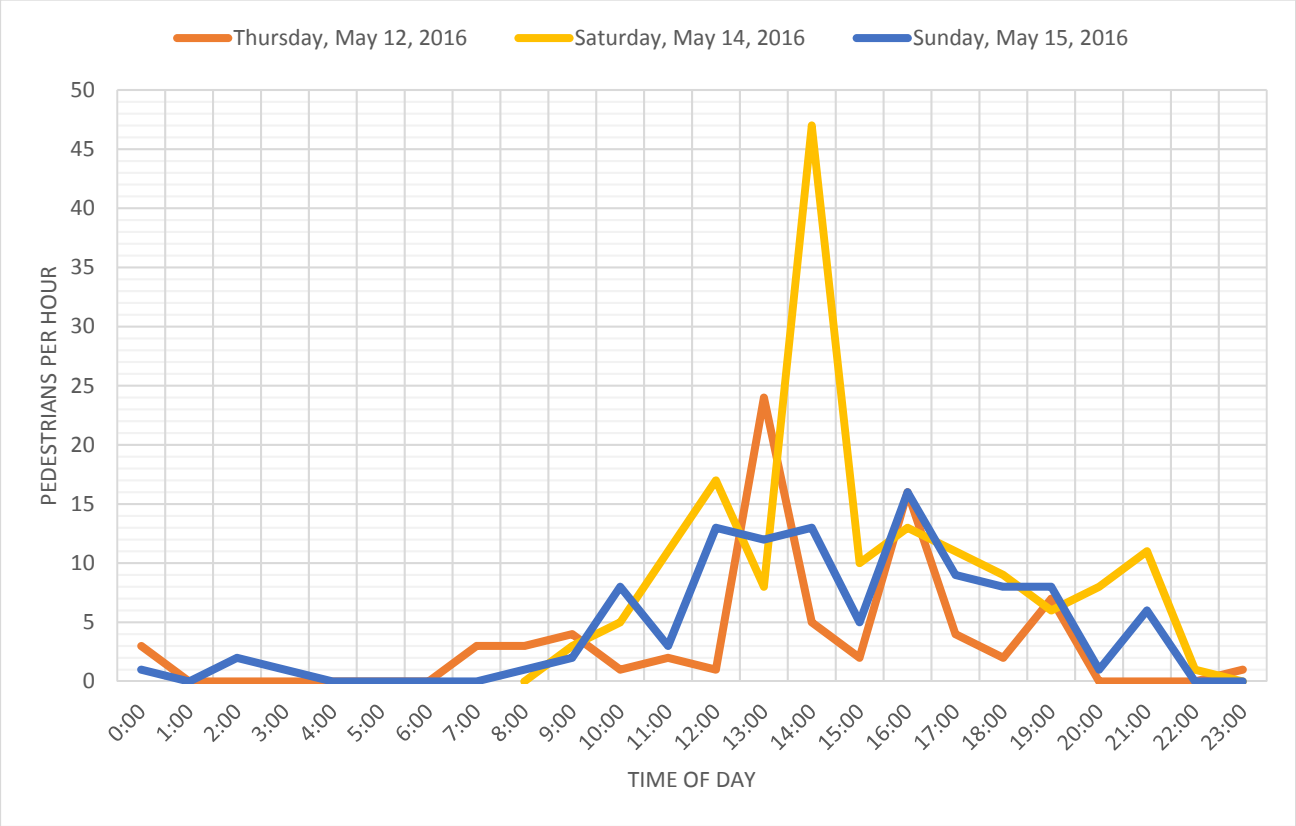
3.5.2 Non-Motorized Facilities and Usage

The existing 3'- 9" wide pedestrian walkway was installed onto the structure without consideration of the impacts to the truss bridge structural system. The walkway provides a main crossing for pedestrians across the Swan River leading to both Sliter Park and to downtown Bigfork.

The current walkway does not meet ADA requirements[21] for accessibility which requires a continuous 4-foot, clear width. The existing railing is of concern due to its dated style which provides minimal protection.

Figure 6 shows the hourly pedestrian volumes for the pedestrian walkway during May 2016.

Figure 6: Hourly Pedestrian Volumes – May 2016



An average of 133 pedestrians were observed using the Swan River Bridge per day. The peak day for pedestrians occurred on Saturday with the highest hourly period of nearly 50 pedestrians occurring between the hours of 2:00 pm and 3:00 pm.

[21] Public Rights-of-Way Accessibilities Guidelines (PROWAG) Section R302.3

3.5.3 Bridge Segment Level of Service

Level of Service (LOS) is used to measure the operational function of a roadway segment. LOS is measured on a scale from A to F correlating to the amount of time delay in seconds. A LOS of A is the optimal condition and considers traffic to flow freely, where a LOS of F represents traffic being congested and resulting in long delays.

LOS for Swan River Bridge was not analyzed due to the community's desire (and the agency's concurrence) to maintain a single-lane bridge. Peak hour factors were also not developed due to the unique approach to this project.

3.6 Local Planning

As an unincorporated community within Flathead County, Bigfork utilizes special districts for infrastructure services (stormwater, sewer and water, etc.). The County Road and Bridge Bureau is responsible for the bridge, the adjoining walkway and the adjoining public streets. Flathead County Parks administers the maintenance and care of the adjoining Sliter Park which is owned by the Pacificorp utility company.

The 2009 Bigfork Neighborhood Plan, adopted by the County in 2009, provides growth guidance for the local area. The Bigfork Land Use Advisory Committee (BLUAC) is an ad-hoc group providing local input for area planning and land use.

The County's Draft Long Range Transportation Plan[22] did not identify any Swan River Bridge or Bridge Street improvements (note this was a draft and not adopted). The 2007 Flathead County Growth Policy did not identify any specific proposals for the Swan River Bridge or Bridge Street improvements. The Flathead County Parks & Recreation Master Plan also did not identify any specific proposals for the Swan River Bridge or Bridge Street improvements.

[22] 2009 Draft Flathead County Transportation Plan-Phase II, Robert Peccia and Associates, 2009.

4 SOCIAL AND ENVIRONMENTAL CONDITIONS

A separate report, the E-Scan Report, identified existing physical, biological, social and cultural resources within the study area that may be affected by future proposed improvements. Any improvement options forwarded from this feasibility study to project development would need to comply with all applicable federal, state and local rules and regulations and would analyze potential impacts to determine appropriate prevention measures and necessary permits. **Figure 7** summarizes potential impacts for the physical, biological, social and cultural resource areas.

Figure 7: Summary of Potential Environmental Issues

Resource	Description
Hazardous Materials	• Due to its age, lead-based paint should be assumed to exist on the bridge and asbestos may be contained in the concrete abutments. • The Pacificorp transformer yard Superfund site is located within the study area, south of the bridge. DEQ is currently sampling the soil in the area and the results should be examined for impacts to any bridge improvement project. • Future coordination with DEQ and others is advised to monitor the underground contamination status. • Underground contamination should be anticipated in the area.
Surface Waters, Wetlands and Floodplains	• The Swan River is a "Water of the US" and is considered a Montana navigable water way. • Wetlands and the Swan River 100-year floodplain exist surrounding the bridge.
Threatened and Endangered Species	• Bull trout and grizzly bear (threatened species) may be encountered within the study area. • The Spalding's catchfly and Yellow-billed cuckoo (also threatened species) have the potential to be encountered within the study area; however habitat for these species are limited. • No species of concern have been identified within the study area. • The study area is used by migratory birds.
Noxious Weeds	• 13 noxious weed species are identified within the study area.
Cultural Resources	• Swan River Bridge is listed on the NRHP under both Criterion A and Criterion C and is subject to Section 4(f) regulations. • Changes to the bridge overhead truss portions are expected to affect the listing.
Recreational and Visual Resources	• Recreational resources exist at Sliter's Park and on the Swan River. • Section 4(f) or Section 6(f) impacts are not currently anticipated at Sliter's Park. • Visual impacts for the bridge, from Sliter's Park, the historic fishing hole and adjacent properties should be assessed if improvements are forwarded.

5 CONCLUSION

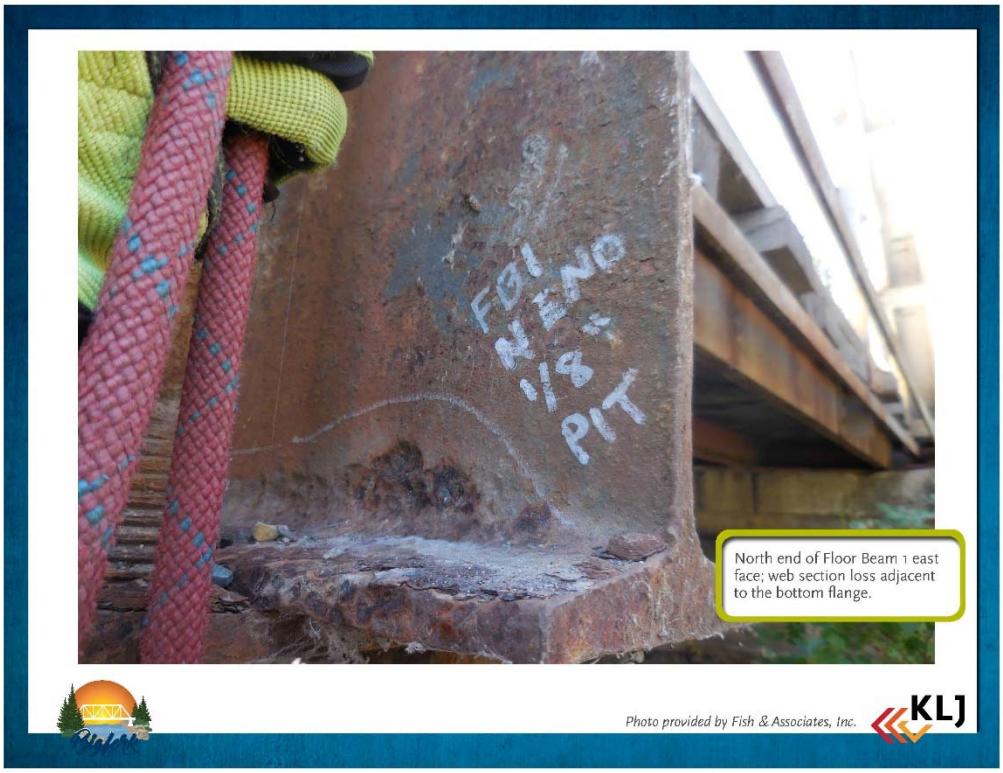
This Existing and Projected Conditions Report identifies key elements of the Swan River Bridge and presents physical, biological, social and cultural features within the boundary of the study area. **Figure 8** summarizes the key transportation system issues and constraints within the study area.

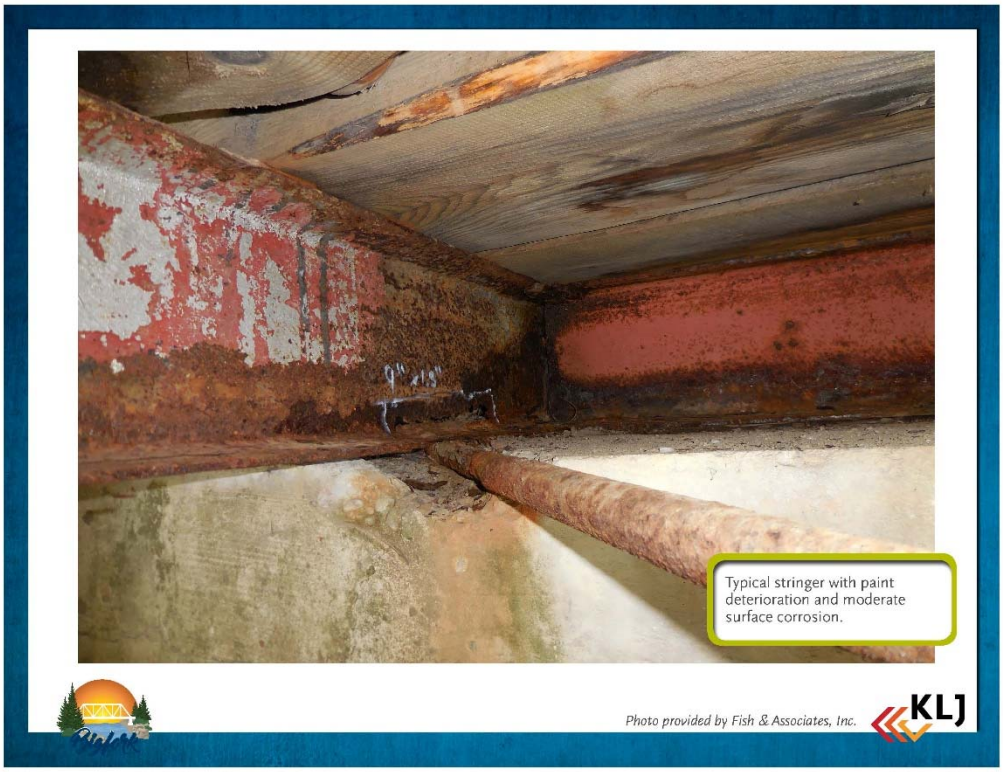
Figure 8: Summary of Transportation and Bridge Issues

Element	Issue	Description
Bridge Condition	Fracture Critical	The design of this structure does not provide redundancy; failure of a single metal component could cause the collapse or failure of the structure.
	Load Rating	Many components have very low load ratings (below the 1.0 factor to adequately support vehicular loads). This is driven by continuing corrosion to steel members and the offset loading incurred by the unsymmetrical walkway. Controlling load rating factors (LRF) are: • Exterior stringer LRF 0.05 • Floor beams LRF 0.288 • End Vertical Web Members LRF 0.431 • Wooden Deck LRF 0.618
	Seismic Support	The ability of the bridge to withstand a seismic event is unknown, due to its construction prior to development of any seismic codes.
Road Operations	Single Lane Bridge	The community strongly supports retention of a single-lane bridge. The County (owner) and the MDT concur that this may be acceptable. Road operations (LOS) are not a deciding factor for any project resulting from this study. Crashes have not been recorded on the bridge or in the near vicinity.
	Pedestrian Walkway	The separated walkway is critical to safe crossing of the river. The current walkway does not meet ADA or safety standards.
Historic Status	NRHP Listing	The bridge is listed on the NRHP due to its integrity and its value to the history of Bigfork. Changes to the bridge overhead truss portions are expected to affect the listing.
	Appearance	The local community strongly desires the overhead steel truss appearance be retained.

Appendix 1: Bridge Photo Log


South end of Floor Beam 3', east face; web section loss adjacent to the bottom flange.
Photo provided by Fish & Associates, Inc.
KLJ


FBI
NEND
1/8"
PIT
North end of Floor Beam 1 east face; web section loss adjacent to the bottom flange.
Photo provided by Fish & Associates, Inc.
KLJ



Typical stringer with paint deterioration and moderate surface corrosion.

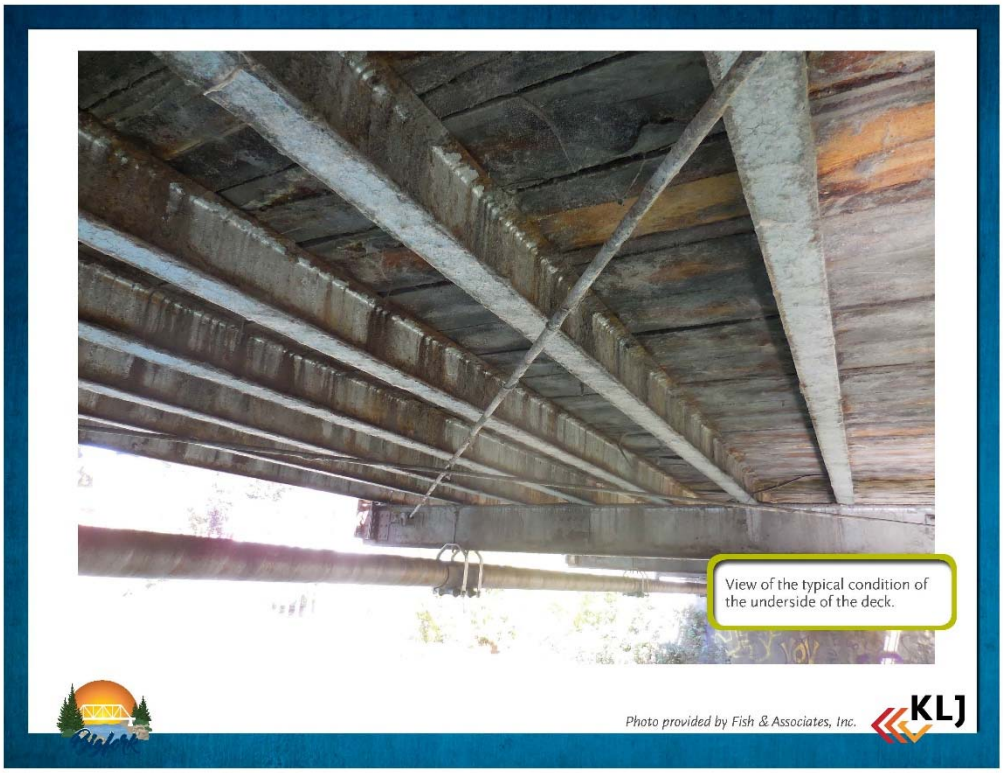
Photo provided by Fish & Associates, Inc.

View of deterioration on Stringer 1 at Abutment 2.

Photo provided by Fish & Associates, Inc.

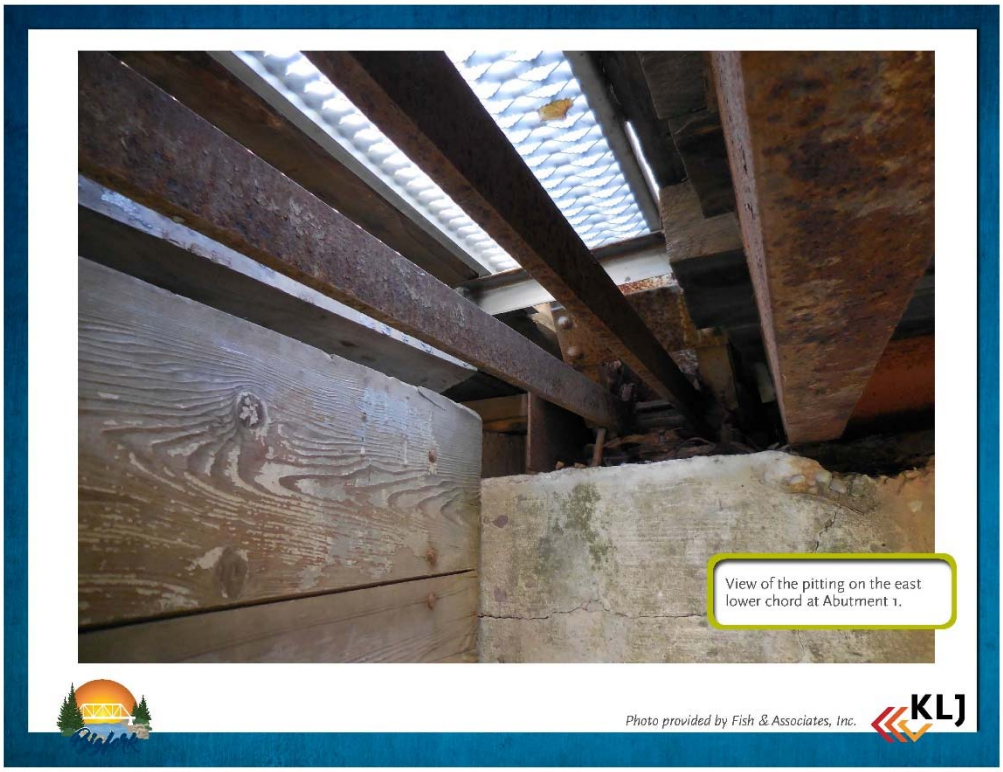
View of deterioration on Stringer 8 at Abutment 2.

Photo provided by Fish & Associates, Inc.



View of the typical condition of the underside of the deck.

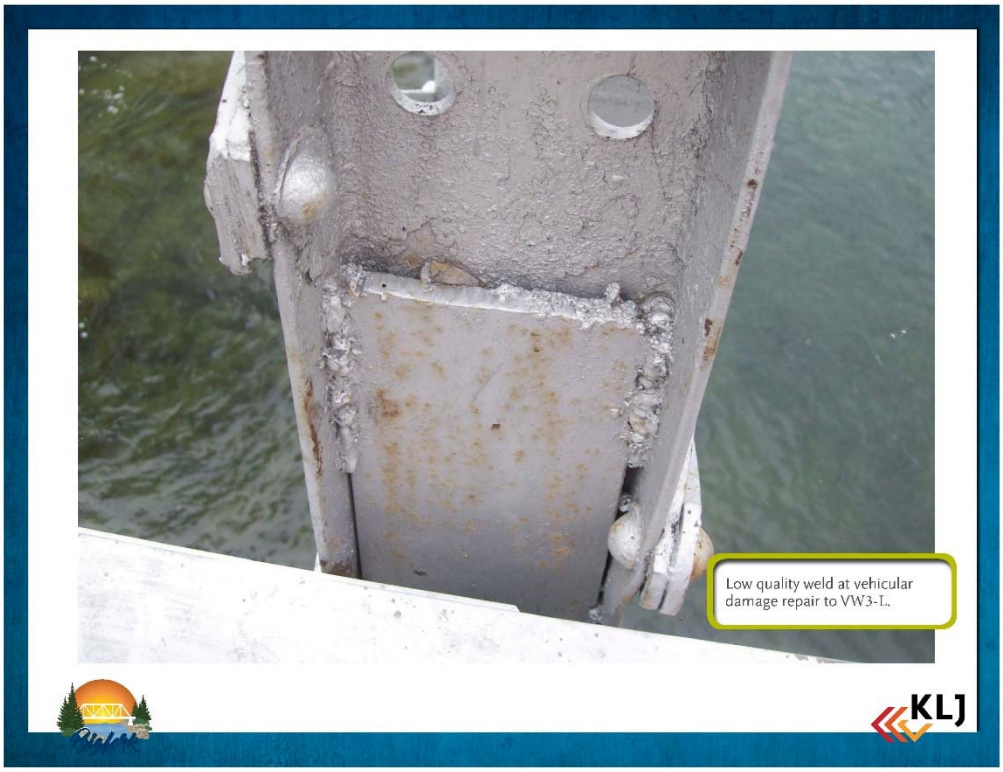
Photo provided by Fish & Associates, Inc.



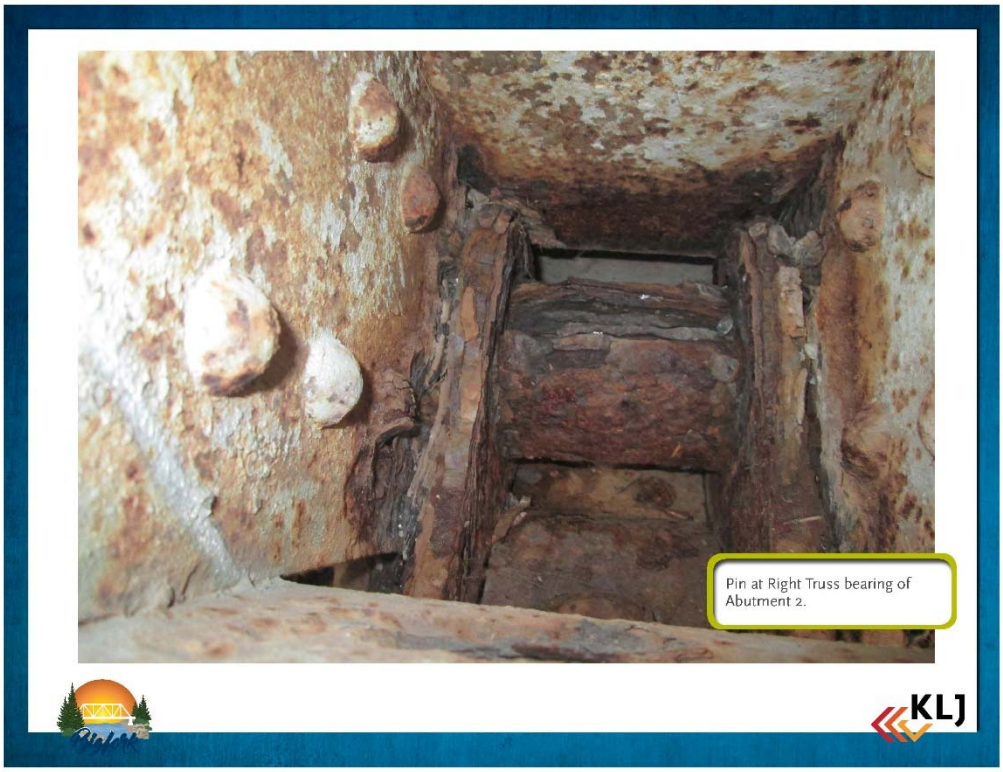
View of the pitting on the east lower chord at Abutment 1.

Photo provided by Fish & Associates, Inc.

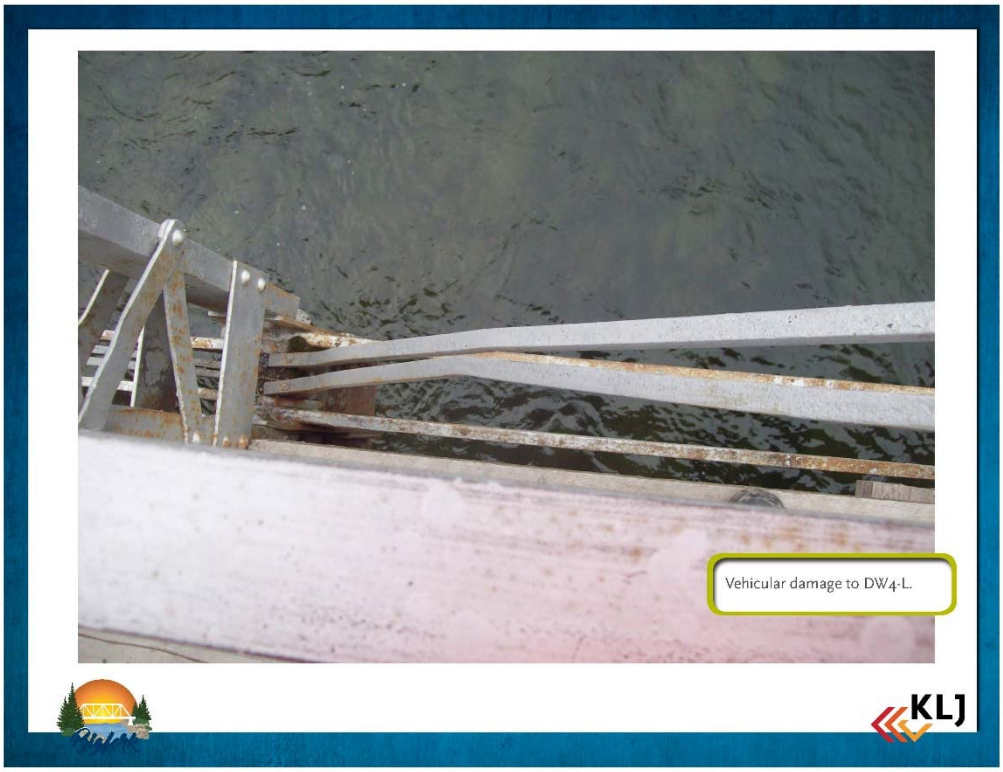
Corrosion of a Roller Bearing at Abutment 2.


Low quality weld at vehicular damage repair to VW3-L.
KLJ


Pin at Right Truss bearing of Abutment 1. Note the splitting and deep section loss on both the truss pin, and the bottom chord.
KLJ


Pin at Right Truss bearing of Abutment 2.
KLJ


Twisting of Steel Stringers.
KLJ


Vehicular damage to DW4-L.
KLJ

Appendix 2: Bridge Component Descriptions

The Swan River Truss Bridge was constructed using the following types of steel members:

- Truss Members:
  - Top Chord Members are constructed using a pair of C8x11.5 channels with a ¼" thick cap plate on top and ¼" batten plates spaced at regular intervals on the bottom side of the channels.
  - Bottom Chord Members are constructed using forged eye-bars that connect from pin to pin along the bottom of the truss. The eye bar dimensions vary between each bottom chord member depending on location and load demands.
  - Vertical Web Members are constructed using a pair of 7/8" by 7/8" square rods at the ends of the bridge (VW1 and VW6). The vertical web member VW6R has been retrofitted with one of the 7/8" square rods being replaced by a 1½" diameter round steel rod. The interior vertical web members (VW2, VW3, VW4, and VW5) are constructed using a pair of C5x6.7 channels laced together with ¼" thick bars.
  - Diagonal Web Members are constructed using forged eye-bars that connect from one bottom pin to an adjacent top pin. The eye bar dimensions vary between each diagonal web member.
  - Braces and Struts are constructed using angle irons at the portal bracing and at the struts at the top chord level between the trusses. The sway bracing between top chords and the lateral bracing between bottom chords are constructed using diagonal tension rods.
- There are six floor beams that are constructed from S15x42.9 steel beams and span between the left and right trusses.
- Stringers (three types):
  - The two exterior stringers are C8x11.5 channels.
  - The interior stringers at the end truss panels are W8x15 beams.
  - In the interior stringer spans, the interior stringers are S8x18.4 beams. Stringers span from the abutment to a floor beam for the end stringer spans, or one floor beam to another for all interior stringer spans.
- The Bridge Deck is made of 4" thick by 9-½" wide wooden deck planks that span across all stringers (perpendicular to the direction of traffic). There is also a running plank wearing surface made of 2-½" thick by 9-½" wide wooden planks (parallel to the direction of traffic). The deck timber is not preservative treated.
- Pedestrian Walkway:
  - The main support members consist of S4x7.7 beams spaced at four feet on center. The beams are supported by the exterior three stringers on the right (upstream) side of the bridge.
  - The wooden deck of the walkway consists of 3" thick x 12" wide planks that run lengthwise (parallel to direction of traffic).
  - Steel pipe handrails and 3" x 3" 3/16" angle iron posts are braced by overhead C5x6.7 channels spaced at approximately 13 feet on center.

Appendix 3: Bridge Component Deficiencies

- Truss Members:
  - The truss pins at the bearings on the right (upstream) side of the bridge have pitting and splitting corrosion[1] and are estimated to have approximately 1/8" of section loss all around the pin for a total reduction in effective diameter of ¼". Pack rust is also visible at the bottom chord eye bars and bearing devices.
  - The truss pins at the bearings on the left (downstream) side of the bridge have pitting corrosion and are estimated to have approximately of 1/32" of section loss all around the pin for a total reduction in effective diameter of 1/16". Pack rust is visible at the bottom chord eye bars and bearing devices.
  - Eye bars BC1-R, BC1-L, BC7-R, and BC7-L all have 1/16" of section loss due to corrosion.
  - The diagonal tension-only members DW1, DW2, DW3, DW4, DW5, and DW6 on both sides of the bridge are identified as being loose or out of straight. These members were accordingly reduced in capacity per engineering judgement to only 90% of their theoretical capacity for the load rating analysis.
  - The vertical tension only members VW1 and VW2 on both sides of the bridge are identified as being loose or out of straight. These members were accordingly reduced in capacity per engineering judgement to only 90% of their theoretical capacity for the load rating analysis. These members were also identified as having a 2" long forge crack at the eyes of the bars.
  - The vertical web member VW3-L has sustained substantial vehicular damage. Attempts have been made to repair the member including re-bending it back to be approximate straightness, and welding a 3/8" thick by 4" wide by 31" long web double plate onto the C5x6.7 channel on the interior of the two channels that comprise the member. The weld quality on the repair is porous and inconsistent. Per engineering judgement for an out of straight compression member, this member was reduced to only 60% of its theoretical capacity for the load rating analysis.
  - The diagonal web member DW4-L has sustained vehicular damage and one of the rods is approximately 2" out of straight. This member is adjacent to VW3-L and likely sustained damage from the same vehicle impact as VW3-L. For an out of straight tension only member with vehicle damage, the capacity of this member was reduced per engineering judgement to 90% of its theoretical capacity.
- Floor Beams: All floor beams have varying amounts of paint loss, rusting, and section loss.
  - All floor beams have 1/8" of section loss due to rusting in the lower portion of the beam webs.
  - The ends of the floor beams and web adjacent to the top side of the bottom flange have nearly complete paint loss and are the locations of the most pronounced corrosion[23].
  - Floor beam 1 (i.e. the floor beam closest to abutment 1 at the southwest end of the bridge) is slightly twisted.
  - Floor beam 3 has a ½" diameter hole through the web of the beam due to corrosion. Corrosion of the floor beam webs is most consistent on the right (upstream) side of the bridge.

[23] Condition evaluation report by Fish & Associates for MDT in September 2015.

  - Floor beam corrosion on the right side of the bridge is possibly due to the use of de-icing salts used on the adjacent pedestrian walkway[24].
  - The increased deterioration at the ends of the floor beams is caused by more exposure to precipitation, and the dirt and debris from the roadway and or walkway above that accumulate there and hold moisture.
  - The floor beam hangers are pitted and corroded. This corrosion is accelerated by the dirt and debris falling from the roadway above.
- Stringers: The stringers have varying degrees of paint loss and rusting. Section loss is evident at some floor beam locations.
  - The exterior C8x11.5 stringers on both sides of the bridge and at both ends of the bridge have severe corrosion and section loss. Holes due to corrosion through the channel web ranging in length from 6" to 14" and in height from 1.5" to 3" are present in those 4 exterior stringers. The bottom flange of stringer 1 at abutment 1 also has approximately 3/16" of section loss due to corrosion in the area of the bearing.
  - Some stringers have corroded to the point where a hammer blow could nearly penetrate through the top flange, as noted during the deck replacement in 2015.
  - Various stringers show minor twisting. Because of this twisted condition, the deck is not permitted to act as a brace for the stringers.
- Paint Coating: Much of the paint system has failed below the deck level. Speckled rust is observed throughout much of the truss. The truss was most recently painted in 2004. No cleaning was done prior to repainting because of lead based paint underneath. The stringers and floor beams were not painted in 2004. Due to the extensive corrosion on certain stringers and floor beams, these components are considered beyond repair with paint.
- Deck Planks: The 4" thick transverse timber deck planks were installed in summer 2004. The transverse deck planks show minor checking, splitting, and minor fungal growth due to moisture. Approximately 75 percent of the 2-1/2" thick longitudinal running planks were replaced in fall of 2015. All 2-1/2" thick longitudinal walkway planks were replaced in the fall of 2015. All deck and walkway lumber is non-treated lumber.
- Portals and braces: New paint coat applied in 2004. No cleaning was done because of previous coat(s) of lead based paint underneath.
- Reinforced Concrete Abutments: Cracking and spalling is noted on both abutments but no rebar is exposed. Minor abrasion is noted on abutment 2.

The damage and deterioration to bracing and non-vehicular load carrying members is as follows:

- Braces and Struts:
  - A new paint coat was applied to portal braces struts and sway bracing between top chords in 2004. No cleaning was done prior to repainting due to the presence of lead based paint.
  - Lateral bracing (between floor beams) shows nearly complete paint loss, and moderate corrosion across the surface of the braces. The bottom lateral bracing near the bearings is highly corroded and has an estimated 1/16" of section loss.
- Walkway rails: Rails have minor paint loss and speckled rust.

Vehicular rails and approach rails: Rails have minor rusting and some minor dents.

[24] Conversations with Flathead County Road & Bridge personnel, March 2016

Appendix 4: Ownership Documentation Overview

Bridge Street R\W at Bridge Location

The following description is the location and status the Right-of-Way of Bridge Street on north and south side of the historic bridge that crosses the Swan River. The status of the Right-of-Way is separated into the north and south side of the bridge in question. The road came into existence at different times and means.

The difference between easement and fee title is more of a technicality because it is a public R\W. Road, bridges and utilities can be constructed within the R\W limits. All the above listed surveys consider the R\W as being Public.

North Side

In reviewing the multiple surveys on the north side of the bridge, there are some differing views on the location and status of Bridge Street. The location discrepancy is located at the corner of the road and not at the river crossing. The easement or fee interest status of the road located at the bridge may be of concern if additional R\W is needed. The following is a brief description of the surveys of record in the area.

- Per the circa 1901 Plat of Bigfork the dedicated R\W of Bridge Street is 60 foot wide which was centered and abuts the bridge. The Road dedication listed on the Plat states "*And that all Streets, Avenues and Alleys therein contained or hereon shown, are hereby Granted, Donated and dedicated to public use forever.*" Because Bigfork is an unincorporated town, Flathead County may have jurisdiction over the roads. If the R\W was dedicated to Flathead County, then adjoining property owners own to the centerline of Bridge Street. There are other surveys that muddle if the dedication was in easement or fee interest, yet none dispute the existence of the public Right-of-Way.
- Certificate of Survey 2091 indicates the R\W is fee interest and also shows the R\W being centered on the bridge.
- Certificate of Survey 2519 indicates a slightly different location of Bridge Street at the corner, but shows the R\W being fee title.
- Certificate of Survey 7872 shows the bridge being centered in the R\W and eludes to the R\W being fee title.
- Certificate of Survey 8930 shows the R\W being at a slightly different location at the corner, reference C.O.S. 2519. C.O.S. 8930 states that the Bridge Street R\W was not defined in this area and retraced a deed description of the parcel. But it does show the R\W being fee title.
- Certificate of Survey 9805 indicates that the Bridge Street is an easement and the R\W is curved at the corner, no other survey shows a curved R\W.
- Certificate of Survey 13245 shows (ref. C.O.S. 2091) the R\W it being either easement or fee interest by the request of the county attorney and plat department. The surveyor shows the "net and gross" area of the property, including and excluding the R\W.

In conclusion the bridge is centered in the Bridge Street's 60 foot wide R\W, whether the R\W north of the Swan River is an easement or fee interest is uncertain.

South Side of the Bridge

In 1904 a petition for a county road was approved per Book B, Page 51, File No. 247. The county road commenced at the South end of the Bigfork Wagon Bridge, assuming wagon bridge is in the same location. Bridge Street on the south side of the Swan River is a county road, 60 foot wide road easement. The location of the Bridge Street is shown on the following Surveys.

- Bigfork Harbor Phase I shows the North side of Bridge Street and that it is a County Road.
- Certificate of Survey 7872 shows the bridge being centered in Bridge Street, but does not show the location of the R\W south of the Swan River.
- Certificate of Survey 14028 shows the location the Bridge Street south of the Swan River. It describes Bridge Street as being a County Road easement 60 feet wide. The R\W ties into the C.O.S 7872 stating that the bridge is centered in the R\W.

In conclusion, Bridge Street South of the Swan River is a 60 foot wide county road easement and the bridge is centered in the Right-of-Way.

Summary

Bridge Street is a 60 foot wide public Right-of Way. The bridge crossing the Swan River is located in the center of the Bridge Street Right-of-Way. Bridge Street R\W south of the Swan River was created by a county road petition in 1904 and is public easement. The R\W North of the river was created by the Plat of Bigfork in 1901.

Bigfork is unincorporated therefore Flathead County may have jurisdiction over the Bridge Street R\W. If that is the case then the R\W is an easement and not fee title. Counties do not have fee title to lands under county road per MCA 7-14-2107(3) *by taking or accepting interests in real property for county roads, the public acquires only the right-of-way and the incidents necessary to enjoying and maintaining it.* Therefore even though some of the surveys show the property lines along the R\W, the adjacent properties own to the centerline of Bridge Street. Whether or not Bridge Street is fee title or an easement its legal status does not limit the use of the R\W. Roads, bridges, and utilities can be built and/or replaced for the good of the public.