Site Location Study - Mill Creek Bridges

City of Edmonton | 15616

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Table of Contents

TABLES

FIGURES

1.0 Project Background

The City of Edmonton's (the City's) Integrated Infrastructure Services department has identified 11 existing pedestrian bridges requiring replacement through the upper Mill Creek Valley east of 50th Avenue and north of 34th Avenue in Edmonton, Alberta (herein referred to as the Project). The pathway system, including the 11 bridges included in this Project, is well used by pedestrians and cyclists and is a widely considered a valuable resource to the community. The bridge locations are provided in Table 1.1 and depicted in Figure 1.1. The existing pedestrian bridges have experienced progressive deterioration to the point where maintenance activities are unable to correct deficiencies and replacement is required.

ISL reviewed the condition of the existing structures through file review and site investigation. The existing bridge abutments are composed of treated timber and retained fill. Although there are no records to confirm, it appears that the original design intent was for the retained fill to support rig mat superstructures. At several locations the fill has settled, sloughed, or washed out and the rig mat is supported, in part, by the top horizontal timber on the face of the abutment. Generally, this member is connected to the timber piles by a single bolt, not likely designed to support the imposed loads. However, the rig mats generally extend more than a metre beyond the front face of the abutment and rest partially on the ground. In general, the abutments are in poor condition. There is significant pile frost-jacking, fill spilling out under backwalls, rotten timbers, and differential settlement exhibited at several locations.

Ten of the 11 Project bridges are approximately 2.5 m wide with a clear width between handrails of about 2.1 m. Bridge B314 is the exception and is 3.4 m wide with a clear width of 2.9 m between handrails. The existing bridge abutments are composed of treated timber and retained fill with rig mat style superstructures. The City does not have construction records for the bridges, thus the date of construction, original design criteria, and subsurface pile length is unknown.

The City of Edmonton retained ISL Engineering and Land Services Ltd. (ISL) to complete preliminary engineering, detailed design, tendering and construction support, resident engineering services, post-construction services, and overall project management for the replacement of the structures. On March 17, 2020, ISL consulted with the City of Edmonton's Urban Form and Corporate Strategic Development (Urban Form) and determined that replacement of the existing bridges would be considered Major Work and thus require an Environmental Impact Assessment (EIA) and Site Location Study (SLS) under Bylaw 7188, to be reviewed by internal City departments and finally by City Council. Urban Form deemed it to be acceptable to include all 11 bridges in one report. This Site Location Study (SLS) has been developed as scoped with Urban Form and is described in the EIA Terms of Reference (TOR).

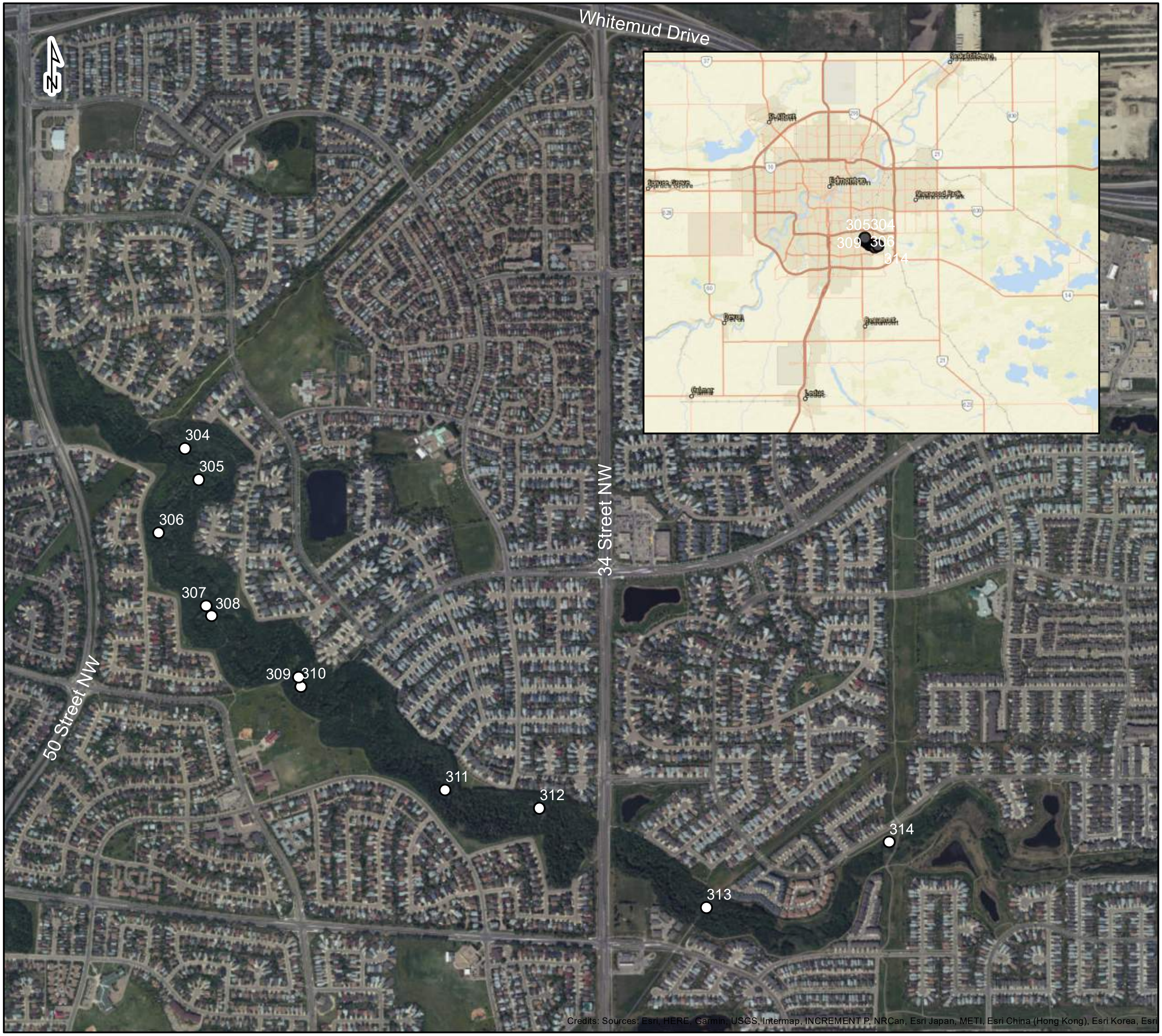
1.1 Project Location and Setting

The 11 existing pedestrian bridges are located in the Mill Creek Ravine east of 50th Avenue and north of 34th Avenue in Edmonton (Table 1.1 and Figure 1.1). The bridges all span Mill Creek which flows northward to the North Saskatchewan River. Mill Creek is part of the City's ecological network and is one of the City's Biodiversity Core Areas as it provides an important habitat area and natural ecological corridor to the North Saskatchewan River (City of Edmonton 2020).

The Mill Creek Ravine east of 50th Street and north of 34th Avenue is a treed natural area with a gravel pathway system that meanders through the ravine passing over the creek several times, including at the 11 bridge locations. The pathway system is heavily used and known to be a favorite by walkers, dog walkers and mountain bikers for recreational purposes. Pathways connect to the North Saskatchewan River Valley via the street network. Surrounding the ravine on the upslope is primarily residential including the communities of Minchau, Kiniski Gardens, Silverberry and Wild Rose. The Minchau Elementary School is located on the south side of the Ravine approximately between Bridge 311 and Bridge 310.

Table 1.1: Bridge Locations

Bridge ID	Address	Legal Description	Legal Location
B304	124 - KULAWY DRIVE NORTH NW	Lot 10ER, Block 40, Plan 9222564	NW 12-52-24 W4M
B305	3943 - 47 STREET NW	Lot 11ER, Block 40, Plan 9321873	SW 12-52-24 W4M
B306	3943 - 47 STREET NW	Lot 11ER, Block 40, Plan 9321873	SW 12-52-24 W4M
B307	190 - KULAWY DRIVE NW	Lot 27ER, Block 45, Plan 9825986	SW 12-52-24 W4M
B308	190 - KULAWY DRIVE NW	Lot 27ER, Block 45, Plan 9825986	SW 12-52-24 W4M
B309	190 - KULAWY DRIVE NW	Lot 27ER, Block 45, Plan 9825986	SW 12-52-24 W4M
B310	190 - KULAWY DRIVE NW	Lot 27ER, Block 45, Plan 9825986	SW 12-52-24 W4M
B311	2423 - KAASA ROAD WEST NW	Lot 16ER, Block 48, Plan 9825737	NE 1-52-24 W4M
B312	2423 - KAASA ROAD WEST NW	Lot 16ER, Block 48, Plan 9825737	NE 1-52-24 W4M
B313	2803 - 34 AVENUE NW	Lot 59ER, Block 45, Plan 0125039	NW 6-52-24 W4M
B314	2710 - 33 AVENUE NW	Plan 5766KS Blk RW Lot 52	NW 6-52-24 W4M



Legend

○ Mill Creek Bridges

0 65 130 260 390 520 Metres

1:15,000 CANA83-3TM114

Figure 1.1
Bridge Locations

Mill Creek Bridges

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2.0 Project Scope

2.1 Scope of Work and Project Components

2.1.1 Structural Alternatives

The structural alternatives report presented the three structural alternatives for replacement of the bridges, which are exhibiting signs of deterioration and require significant intervention to maintain access over Mill Creek (Table 2.1 and ISL 2020). Three scenarios were identified and evaluated to renew the structures:

- Option 1: replacement of the substructures;
- Option 2: complete replacement of the substructures and superstructures with build-in-place solutions; or
- Option 3: complete replacement of the substructures and superstructures with prefabricated bridges.

Design criteria for the new bridges were provided by the City. It was established that the new bridges would be designed to the CSA S6-19, including use of the S6-19 Maintenance Vehicle (80kN) for the design vehicle. The bridges are to provide a clear width of 3 m, and there will be no change to the type or width of the pathways except to tie-in to the new bridge width and elevations.

ISL completed a field review of the existing bridges as well as a desktop review of the limited available file information. The bridges vary from site to site but there were several deficiencies common to multiple sites. The timber substructures had deficiencies such as timber rot, frost jacked piles, fill spilling out under backwalls and wingwalls, and fill settlement. In some cases, the abutment had partially failed, and the superstructure end had settled into the abutment fill. The rig mat superstructures were in better condition than the substructures, but as part of the functional review, ISL evaluated the load carrying capacity of the existing superstructures and found that they are not able to support the design vehicle load.

ISL evaluated the three scenarios and recommended proceeding with Option 3, complete replacement of substructures and superstructures with prefabricated bridges. The existing bridges do not have adequate load carrying capacity, so Option 1 was not further considered. Of the two full replacement options, replacement with a prefabricated bridge was found to have a lower capital cost and a lower net present value. Additionally, this option is a lower maintenance bridge type. The typical bridge drawing is provided below in Figure 2.1 for an example of the changes, showing the removal of the existing bridge, channel armoring, alteration to approaches and typical tree removal. Individual drawings will be developed for each bridge through the detailed design phase.

Table 2.1: Bridge Current Condition

Bridge ID	Substructure	Superstructure	Handrail
B304	Rotten timber. Fill settlement and/or pile frost-jacking, wingwalls pulled apart, fill spilling out of backwalls	Minor surface corrosion on the steel beams on the rig mat, Portion of rig mat below grade.	Failing coating
B305	Rotten timber. Fill settlement and/or pile frost-jacking, wingwalls pulled apart, fill spilling out of backwalls	Minor surface corrosion on the steel beams on the rig mat, Portion of rig mat below grade.	Failing coating
B306	Rotten timber. Fill settlement and/or pile frost-jacking, wingwalls pulled apart, fill spilling out of backwalls	Minor surface corrosion on the steel beams on the rig mat	Partially painted
B307 (two span structure)	Rotten timber, wingwalls pulled apart, frost-jacking	Minor surface corrosion on the steel beams on the rig mat	Isolated patches of paint
B308	Rotten timber. Fill settlement and/or pile frost-jacking, wingwalls pulled apart, fill spilling out of backwalls	Minor surface corrosion on the steel beams on the rig mat, Portion of rig mat below grade.	Partially painted
B309	Rotten timber. Fill settlement and/or pile frost-jacking, wingwalls pulled apart, fill spilling out of backwalls	Minor surface corrosion on the steel beams on the rig mat, Portion of rig mat below grade.	Isolated patches of paint
B310	Frost-jacking/settlement, fill spilling out below backwalls and wingwalls	Minor surface corrosion on the steel beams on the rig mat	Partially painted
B311	Frost-jacking/settlement, fill spilling out below backwalls and wingwalls	Minor surface corrosion on the steel beams on the rig mat	Failing coating
B312	Frost-jacking/settlement, fill spilling out below backwalls and wingwalls	Minor surface corrosion on the steel beams on the rig mat	Rail extends beyond bridge
B313	Frost-jacking/settlement, fill spilling out below backwalls and wingwalls	Minor surface corrosion on the steel beams on the rig mat	Good
B314	Absence of rock on headslopes	Minor surface corrosion on the steel beams on the rig mat	Good

Source: Structural Alternatives Report (ISL 2020)

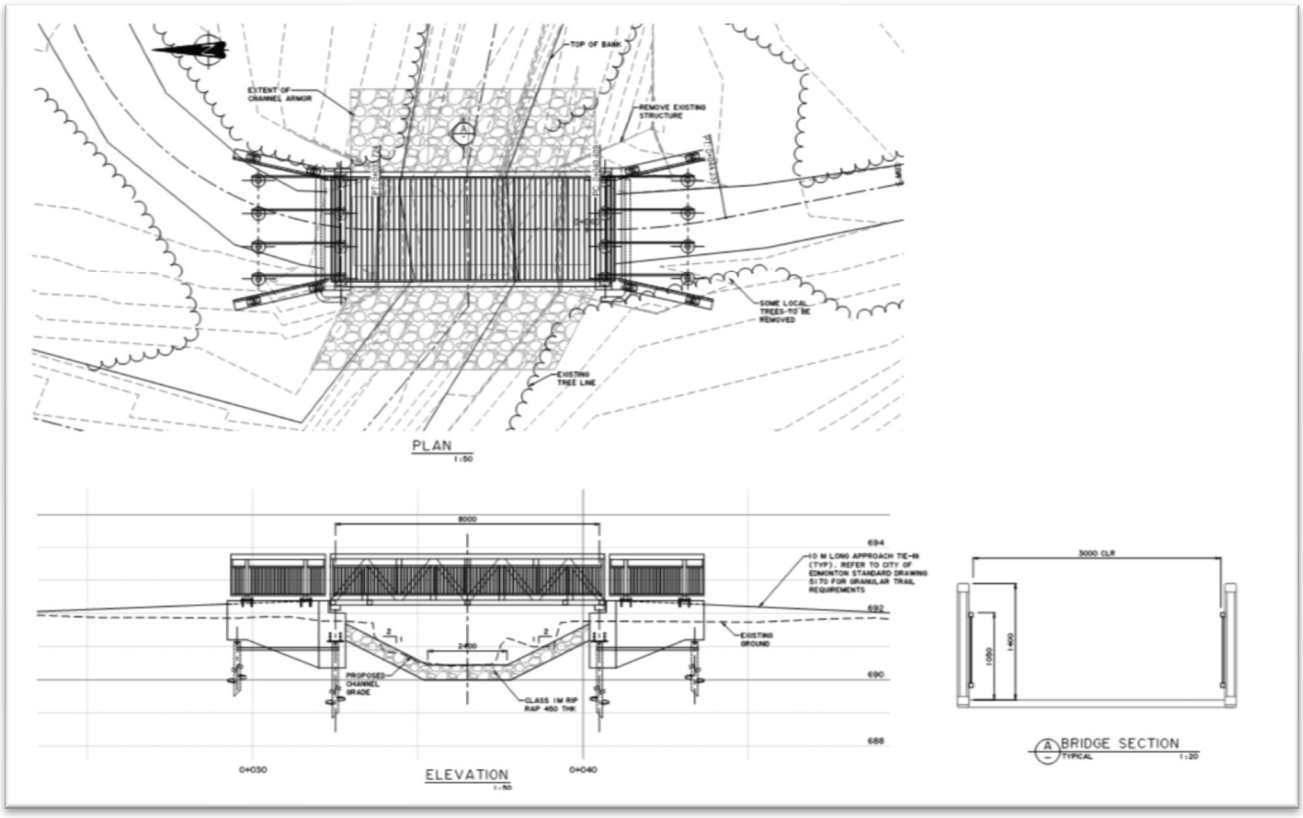

Figure 2.1: Typical Bridge Replacement General Arrangement

Removal and Replacement of the Bridges B304 to B314

In advance of construction, the existing bridge structures will be completely removed, including the existing abutments. The removal of the bridges will likely include a combination of manual labour and use of conventional construction equipment (e.g. excavator). All removed material will be transported off-site and disposed of appropriately. The precise methodology for bridge removal will be determined by the Contractor subject to approval by the City. There is opportunity that the Contractor may utilize the existing bridge structure as a crossing structure during construction to maximize re-use.

The new steel truss bridges are to be constructed on an alignment similar to the existing structures. The new bridges will all be single span structures with span length between 8 m and 12 m. This is an increase in span length at all sites except B307, where the overall length of the existing two span structure is being reduced. The new bridges will be widened to provide a 3.0 m clear width. Depending on the existing conditions and hydrotechnical requirements, the bridge elevation and freeboard will remain the same or increase.

Work will involve the complete removal of the existing bridges. Bridge foundations will be replaced with new concrete abutments and wingwalls founded on screw piles or drilled cast-in-place concrete piles anchored below frost depth. The existing rig mat style superstructures will be replaced with weathering steel truss bridges with timber decking. A new 1.4 m pedestrian handrail will be provided on the bridge and extended onto the abutment wingwalls where required. To protect the long-term structural integrity of the bridges, tree clearing will be required in the immediate vicinity of the bridges. Tree clearing will be carried out in accordance with the Tree Preservation Plan.

3.0 Location Analysis and Justification

A location analysis as per the TOR agreed upon with Urban Form is provided in the following sections. The following refer to all bridges (B304 to B314).

3.1 Other Locations Considered

This Project is the removal and replacement of existing bridge infrastructure located within the North Saskatchewan River Valley Area Redevelopment Plan. The bridges provide connections to the existing pathway network in the ravine and replacement of the bridges at their current locations is preferable as it provides the least new disruption to environmental features and construction efficiencies. Replacement at alternate locations would, for example, require additional disturbance to the natural environment (e.g. tree removal) through construction staging and access, the building of additional pathway lengths in which to connect the bridges to existing pathways, and increased costs for rehabilitation of the existing bridge sites and pathways that would be potentially decommissioned as they dead end at Mill Creek.

3.2 Functionality of Project Outside of the North Saskatchewan River Valley

The existing bridges in the Mill Creek Ravine are already located in the North Saskatchewan River Valley and are an essential connective link to the network of pathways within the Mill Creek Ravine. Locations outside of the Ravine were not considered as there would then be no connective purpose.

3.3 Project Dependence on the River Valley or Park Users

The Project is located within the Mill Creek Ravine precisely for use by recreational users. The bridges to be replaced are part of the existing pathway network within the ravine. The ravine and its pathway network are frequented by a variety of park users including mountain bikers, walkers and runners and the bridges are in place to allow users to cross Mill Creek efficiently. Without the bridges in place, it is likely that bicycle and foot traffic crossings would impact the health of Mill Creek, associated aquatic and semi aquatic species and the riparian area.

3.4 Relevant Bylaws and Policies Which Support the Projects Location

The Project is located in the North Saskatchewan River Valley Area Redevelopment Plan (City of Edmonton 2018; Bylaw 7188); and within a Priority 1 and 3 area in the Ribbon of Green Master Plan (City of Edmonton 1992). The other bylaws and policies support the Project location:

- Breathe; Edmonton's Green network Strategy (City of Edmonton 2017), a 30-year strategic plan guiding the care and expansion of open spaces including the trails, corridors and pathways that link them.
- The Municipal Development Plan; The Way We Grow (City of Edmonton 2010a, Bylaw 15100) which supports the City of Edmonton's Natural Connections Strategic Plan (City of Edmonton 2007).
- The Way We Live: Edmonton's People Plan (City of Edmonton 2010b) focusing on people services and quality of life for Edmontonians.
- The Way We Move: Transportation Master Plan (City of Edmonton 2009) encourages a walkable and cycle friendly city.

4.0 Opportunities and Constraints

An analysis of the financial, social, environmental and institutional opportunities and constraints is provided below. This analysis examines the feasibility of locating the Project outside of the North Saskatchewan River Valley.

4.1 Financial Opportunities and Constraints

The main driver of replacement of the bridges is due to structural deficiencies which have potential to lead to public safety issues if left unaddressed. Repair of the existing bridges was considered as an option early in the design process, however the existing bridges do not have adequate load carrying capacity for S6-19 Maintenance Vehicles, and repair was no longer considered a viable option. Consideration of costs for replacement structure options were analyzed and of the two full replacement options, replacement with a prefabricated bridge was found to have a lower capital cost and a lower net present value.

Relocating the bridges to new locations would have resulted in increased costs for more extensive site rehabilitation and restoration of the old bridge locations and of the pathways leading to them. It also would have resulted in additional pathway areas being cut in and laid to redirect pedestrian traffic to new bridges. Replacement of the bridges in their current locations keeps restoration costs to a minimum. Replacement with bridges that withstand the load of maintenance vehicles has the potential to result in more efficient maintenance of the park.

4.2 Social Opportunities and Constraints

The Mill Creek Ravine is a frequently visited natural area valued by all recreational users. The pathway system, including the connecting bridges within the ravine is an essential mode of access for the public to use, experience and enjoy the area. Mill Creek is the focal point of the ravine. Replacement of the bridges at the current locations will maintain the pathway network and alignment as it currently is, allowing for continuity of the view scape and historical recollection for current recreational users of the Ravine. Additionally, wider and structurally engineered bridges will allow for maintenance vehicle access, potentially improving the quality of the park and allowing for better access in emergencies. Wider bridges would also allow for more space between passing users resulting in a more enjoyable and safer recreational experience.

Locating the bridges elsewhere outside of the Mill Creek Ravine would not provide these same social benefits of a connective pathway network in a natural area.

4.3 Environmental Opportunities and Constraints

Locating the new bridges in the same locations as the old bridges provides the lowest appreciable impact to the environment. No new pathways are cut in, no rehabilitation of decommissioned paths is required, and new riparian area disturbance won't be needed to the extent that it would for a new bridge. At the existing bridge locations, only minor widening of pathways to tie into the increased width bridges and some tree clearing for construction will occur. This Project offers the opportunity for enhanced wildlife passage at the bridge locations as the lengths of all bridges except for B307 will increase, providing more passage area than previous within Mill Creek.

4.4 Institutional Opportunities and Constraints

The replacement of the Mill Creek bridges is compatible with the goals of Bylaw 7188, to provide opportunities for recreational activities. Management of infrastructure assets within the Bylaw area is important to meet such goals and projects. The replacement of the Mill Creek Ravine bridges will provide safe and continued connectivity of the pathway network for recreational users. The lifespan of the replacement bridges is anticipated to be 75 years, providing significant cost savings in maintenance due to modern construction materials and construction methods. This portion of the ravine indirectly connects users through the road network to the North Saskatchewan River Valley, however its local importance to the surrounding communities as a place to recreate should not be understated. With Mill Creek itself as the focal point of the ravine, bridges and their connecting pathways provide an opportunity for Edmontonians to enjoy the outdoors, in their own neighbourhood.

5.0 Conclusion

This Site Location Study describes a bridge replacement project for Bridges 304 to 314. The bridges currently in place were constructed mainly of wood and have degraded to a point such that replacement is recommended. The new precast bridges proposed will be steel truss bridges with foundations of with new concrete abutments and wingwalls founded on screw piles or drilled cast-in-place concrete piles anchored below frost depth.

Maintaining the pathway network connections through the bridge locations over Mill Creek, and throughout the Mill Creek Ravine is the goal of this bridge replacement project. The bridges and their associated pathways provide a valued recreational place for cyclists, walkers, and runners and a variety of other recreationalists. Providing recreational opportunities is one of the goals of the North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188) and the location of this Project, within the ravine is crucial in order to continue to provide those same recreational opportunities.

Social, Environmental and Institutional considerations apply in the decision-making process of this Site Location Study, with Financial considerations not contributing to the project location decision.

6.0 References

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Sincerely,

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