CITY OF COURTENAY - SIXTH STREET BRIDGE FEASIBILITY AND OPTIONS REVIEW

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Sixth Street Bridge Feasibility and Options Review

City of Courtenay

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1 INTRODUCTION

The City of Courtenay is currently developing and evaluating various options for improving active transportation connections across the Courtenay River adjacent to downtown. In conjunction to this report, Urban Systems and Hatch Engineering are working with the City of Courtenay to review the options and connectivity of the potential new cantilevers on the Fifth Street Bridge to support improved cycling and pedestrian connections across the river. At the September 16th, 2019 Council meeting, Council directed staff to expedite delivery of a range of options for a Sixth Street Multi-Use Bridge concept in order to provide greater information related to the design, cost, public safety features and funding source options for a Sixth Street crossing. The concept of a Sixth Street crossing is not new and has been discussed numerous times over the past 10 years within the community and at the municipal level. This report will focus on the Sixth Street crossing providing various bridge options and costs, connectivity pieces and ultimately an evaluation and recommendation of the preferred Sixth Street Multi-Use Bridge.

1.1 BACKGROUND INFORMATION

The Sixth Street Multi-Use Bridge concept has been discussed many times within community and at the municipal level in the last 10 years. In 2015, Outlook Land Design and 3D Design prepared a Design Brief detailing a concept design for the Sixth Street Multi-Use Bridge. This design brief explored a cable-stayed structure that was 4.5m wide that provided connections to Simms Millennium Park and Sixth Street.

The Sixth Street Multi-Use Bridge is included in the recently completed Parks & Recreation Master Plan and referenced in the Transportation Master Plan for the City of Courtenay. The bridge is listed as a long-term improvement in the Parks & Recreation Master Plan.

The Sixth Street Multi-Use Bridge would provide a connection between downtown and Simms Millennium Park as well as a connection to the future cycling network along Sixth Street, Anderton Avenue, the Courtenay Riverway Trail, and the pathway connection to the Lewis Centre.

Figure 1 below shows the approximate location of the proposed Sixth Street Multi-Use Bridge and the connections to the park and the future cycling and pedestrian network.

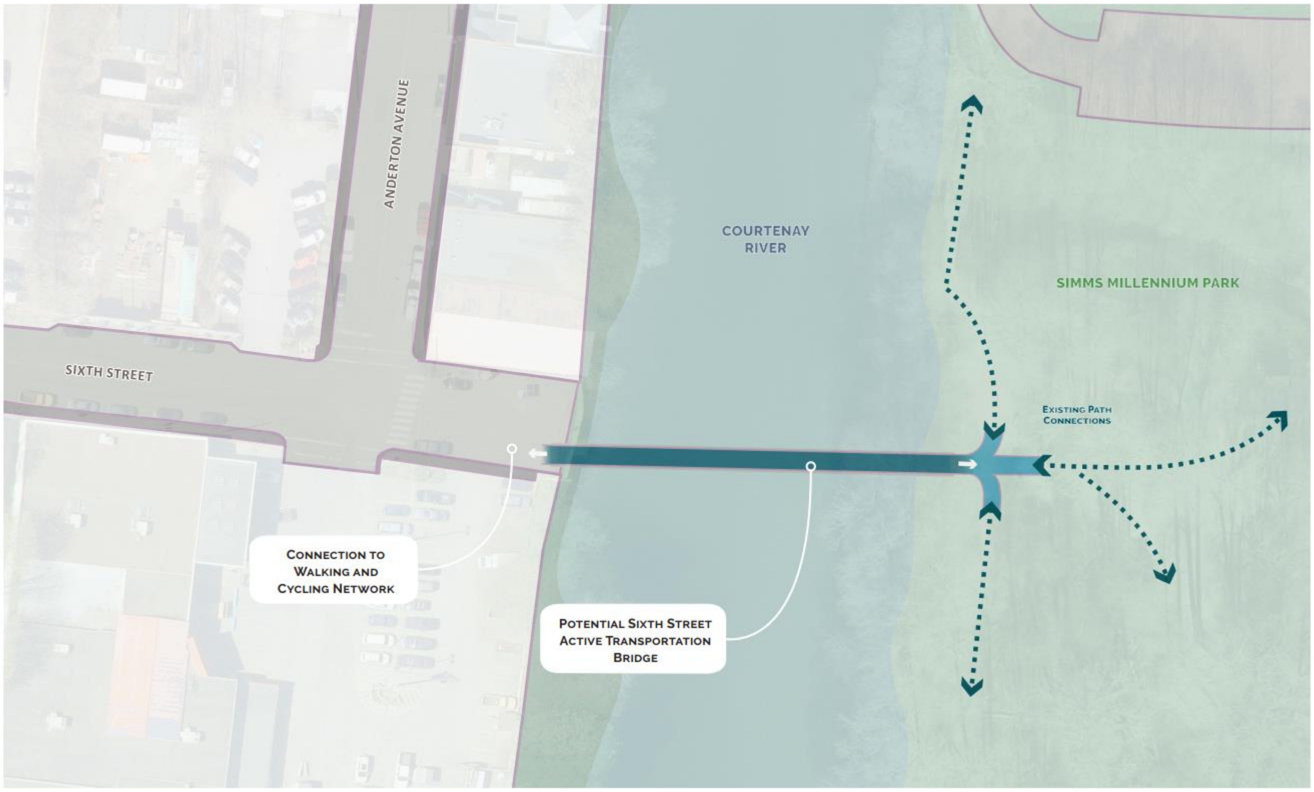


Figure 1: Conceptual Location and Connections of the Sixth Street Multi-Use Bridge

2 COMPARATIVE BRIDGE REVIEW

As a preliminary assessment of design criteria and the range of options for the Sixth Street Multi-Use Bridge, bridges with similar characteristics were identified and are briefly presented below for comparison and to provide a range of options similar to what would be available to the City. The comparison review considered the functional width, user volumes (if available), and bridge decking material of the comparative bridges to help guide the design decisions of the Sixth Street Multi-Use Bridge. These bridges are all located on Vancouver Island or the Lower Mainland of BC and are intended for a mix of active transportation users.

JOHNSON STREET BRIDGE, VICTORIA BC

The new Johnson Street Bridge in Victoria features active transportation facilities on both sides of the bridge. The north pathway, as seen in the **Figure 2** below, is a mixed-use path connecting Downtown Victoria to Vic West, and the E&N and Galloping Goose Regional Trails, making it a hub for active transportation users. This section of the bridge is approximately 5 metres wide and lifts with the bascule bridge. The Johnson Street bridge saw well over 300 bikes in the peak hour in October 2018. The decking is a special non-slick grooved metal surface.

Figure 2: The Johnson Street Bridge multi-use pathway in Victoria, B.C.

SALTON ROAD PEDESTRIAN-CYCLE BRIDGE, ABBOTSFORD BC

The Salton Road Pedestrian-Cycle Bridge in Abbotsford is a multi-use bridge over the Trans-Canada Highway shown in **Figure 3** below. Built as part of the City of Abbotsford's initiatives to improve cyclist and pedestrian safety, the bridge is connected to separated bike paths on neighbouring street. The bridge itself is approximately 4 metres wide. Traffic counts are not currently available for the bridge. The bridge has a smooth concrete surface.

Figure 3: The Salton Pedestrian Bridge in Abbotsford, B.C.

MAFFEO SUTTON WALKWAY, NANAIMO BC

The Maffeo Sutton Walkway Bridge in Nanaimo connects the City's multi-use harbourfront walkway across the mouth of the Millstone River, shown in **Figure 4** below. Approximately 3 metres wide, the bridge's narrower design requires cyclists to dismount before crossing. Traffic counts aren't currently available for the bridge. The bridge has a smooth concrete surface.

Figure 4: The active transportation bridge in Maffeo Sutton Park, Nanaimo, B.C.

3 DESIGN CRITERIA

Design specifications for the Sixth Street Multi-Use Bridge will be based on best practices for multi-use pathways in British Columbia. The *British Columbia Active Transportation Design Guide* (BCAT) provides direction for designing active transportation infrastructure appropriate to a project's context. The guide outlines space requirements for multi-use pathways based on the volume of current and anticipated pathway users, and the ratio of pedestrians to daily pathway users.

3.1 DESIGN WIDTH

Applying this guidance to Sixth Street Bridge requires some approximation of these user volumes. Current and anticipated user volume was estimated from data collected by the Comox Valley Cycling Coalition (CVCCo) on active transportation users on the Fifth Street Bridge in August 2019. The Sixth Street Bridge was assumed to take half of the observed volume on the Fifth Street Bridge, with 5% annual growth for pedestrians and 3% annual growth for cyclists. Based on the CVCCo counts, there would be approximately 785 pedestrians and 386 cyclists per day using the Sixth Street Bridge by 2049.

Based on BCAT guidelines, pathway width should vary with total user volume and the proportion of pedestrian users among total users. For the estimated 1,171 total users with more than 20% of pedestrian users, the BCAT recommends a minimum usable width of 3.5 metres (see **Table 1**).

Table 1: Calculation Guidance for Pathway Widths (from BCAT)

USER RATIO FOR SEPARATION	DAILY ANTICIPATED USER VOLUME FOR VARIOUS PATHWAY WIDTHS (USERS)		
	3m	3.5m	4m
More than 20% of users are pedestrians and total user volumes are greater than 33 persons per peak hour	1,000	1,200	1,400
Less than 20% of users are pedestrians and total user volume is greater than 50 persons per peak hour	1,500	1,750	2,000

Considering that these guidelines are not specific to multi-use active transportation bridges and accounting for future growth in user volume beyond these current estimates, a minimum functional width of 4 metres is recommended for the Sixth Street Bridge. The bridge will also require additional width for structural supports or other components that would be above-and-beyond the recommended functional width.

Further consideration of surface material and design speed are also necessary. BCAT recommends asphalt as an accessible and durable surface that comes at moderate cost. Speed on the Sixth Street Bridge will likely be low due to the mix of users and should therefore conform to the BCAT guidelines, designs speed should be 20km/h for the multi-use facilities. Specific design considerations including curves, signing and pavement markings should be considered during detailed design to keep speed low for all users, especially e-bikes.

3.2 BRIDGE LENGTH

The proposed bridge span length is approximately 60m (196 ft). This bridge length is developed to minimize the span length but to keep the bridge from impacting the Courtenay River waterway. The abutments will be built on the shores of the river and no construction activity will need to take place within the river.

3.3 PATHWAY GRADE

Most design guides indicate that the ideal slope for cyclists and pedestrians is less than 4%, with some stating that up to 5% is appropriate. The current concept design for the bridge shows the grades along the abutment to be at 4%. The grades will be confirmed during the detailed design stage but should strive to be less than 4% or up to 5% for short segments. This will ensure the bridge provides a comfortable experience for individuals of all ages and abilities.

4 BRIDGE DESIGN CONCEPTS

4.1 BRIDGE DESIGN OPTIONS

Several bridge designs options have been reviewed and are presented in the report based on the consulting team's experience and research for the location under consideration, as well as the City's requirements. The bridge abutments and foundations are assumed to be the same for all options, so only the bridge superstructure is presented and evaluated.

The proposed bridge crossing is approximately 60m long and a steel superstructure is considered based on the span length. For the purpose of the report, four bridge types were reviewed to provide a range of aesthetic appeal and costs. The four bridge types are listed below and discussed in the following sections:

- Pre-Engineering Pedestrian Truss Bridge (Bowstring)
- Modular Panel Bridge
- Network Arch Bridge
- Cable Stayed Bridge

A modular bridge recently acquired by the Comox Valley Regional District (CVRD) was reviewed for installation at Sixth Street. However, it was determined that it was not designed to span the full 60m needed for this bridge and such was not evaluated any further. The modular panel bridge included below is similar to the CVRD bridge but is capable of spanning the river.

4.1.1 PRE-ENGINEERED TRUSS BRIDGE (BOWSTRING)

Pre-engineered pedestrian bridges have been a prime choice for many municipalities, transportation authorities, light rail companies, golf courses and developers for many decades. The structures are precision-engineered and manufactured in a controlled factory environment with precise tolerances and key fabrication differentiators, such as welding integrity, mitered end connections, mill scale removal and finish quality.

With top chords arching up from its base, the Bowstring steel truss bridge is a cost-effective combination of visual appeal and design efficiency. Refer to **Figure 5**. Bowstring bridges are available with spans up to 60m in an underhung configuration and up to 62m.

Figure 5: Bowstring Truss bridge

Bridge manufacturers are highly experienced in shipping pedestrian / cyclist bridges throughout Canada and beyond. They can often be installed more quickly than other bridge structure types, using local crews and on-hand equipment. The truss would be spliced in three places off-site and crane lifted as one piece, as shown in **Figure 6**. Due to the width of the bridge deck, there would also be a splice down the centerline to allow shipment. A pressure treated timber deck is considered for economic reasons but cast-in-place concrete is also an option.

Figure 6: Installation of a Bowstring Truss Bridge

4.1.2 MODULAR PANEL BRIDGE

The Modular Panel Bridge system is a conventional truss system that uses 3m pinned panels to achieve clear spans of more than 82m for pedestrian, vehicular and utility support applications. Refer to **Figure 7**. The proposed truss configuration is built from hot dipped galvanized steel. The proposed bridge deck would be steel covered with epoxy aggregate. The manufacturers maintain an inventory of these popular systems ready to be shipped anywhere in Canada for permanent or temporary applications, like detour bridges or emergency bridge washout replacements.

These “Bailey Bridge” style systems are easy to assemble, install and re-use. All components are hot dip-galvanized for maximum durability. They are easy to assemble with local crews and may be reused.

Assembled bridges can be cantilever-launched from one side or they can be crane lifted into place. Assembly and installation examples are shown in **Figure 8** and **Figure 9**.

Figure 7: Modular Panel Bridge

Figures 8 & 9: Assembly and Installation

4.1.3 NETWORK ARCH BRIDGE

An efficient and aesthetically pleasing signature structure can be delivered with the use of a network arch bridge system, as shown in **Figure 10**. The main span of 60m long can be achieved and would be comprised of a painted steel network arch built from curved steel pipes and round bar hangers. The use of bent pipes for the arch ribs and tie beams can significantly reduce structure cost and achieve a slender and elegant look.

The lightweight steel arch is easy to assemble off-site and crane lifted into place as one piece. See **Figure 11**. The concrete deck is cast-in-place concrete cast on galvanized steel stay-in-place forms.

While this type of bridge does provide better aesthetics, it does come at a slightly high cost when compared to the previous two options. Another disadvantage is that additional inspection and maintenance efforts will be required due to the complexity and height of the network arch system.

Figure 10: Network Arch Pedestrian Bridge Example

Figure 11: Bridge Assembly

4.1.4 CABLE STAYED BRIDGE

The 2014 Outlook Land Design report that proposed a cable stayed bridge was reviewed by Hatch as part of this study. The bridge would have a single weathering steel bridge tower on the east bank, with bridge strand cable stays supporting two steel girders that span 60m. The tower would have bridge strand backstays attaching to concrete anchorages within Simms Park. The main girder and bracing system would be galvanized. The proposed cable stayed bridge is shown in **Figure 12** and **Figure 13**. The bridge superstructure would be assembled off-site and crane lifted into place as one piece. The bridge tower erection would be challenging from a construction point of view.

The bridge deck proposed by the previous report is a heavy pressured treated timber deck similar to what is used for government wharfs. A cast-in-place concrete deck can also be used instead of the timber deck.

Of the four bridge design options, this option would have the greatest inspection and maintenance effort due to the complexity and height of the tower. Specialized equipment would also be required for future bridge tower and cable inspections. There is also a higher construction risk associated with this option due to its complexity as compared to the other three options.

Figure 12: Previous Proposed Bridge (by Outlook Land Design)

Figure 13: Previous Proposed Bridge (by Outlook Land Design)

4.2 BRIDGE ABUTMENTS AND EMBANKMENTS

The bridge abutments for all four options would be similar and would consist of a concrete cast-in-place wall, similar to **Figure 14** below, supported on driven 610mm diameter, 25m long, steel pipe piles. The bridge embankments can be built from cast-in-place concrete walls or with the cost effective MSE (Mechanically Stabilized Earth) system. See **Figure 15** for a General Arrangement drawing showing bridge abutments and embankments layouts.

Figure 14: Bridge Embankments

Based on the preliminary geotechnical assessment performed by Levelton in 2012, ground improvement is required at both abutments due to the presence of poor soils and the need to mitigate displacements in conjunction with the pile foundation. Ground improvements would involve installation of stone columns or vibro-replacement points to 10m depth, to increase shear strength to reduce soil liquefaction. The cost of ground improvement is based on estimates provided in previous geotechnical reporting.

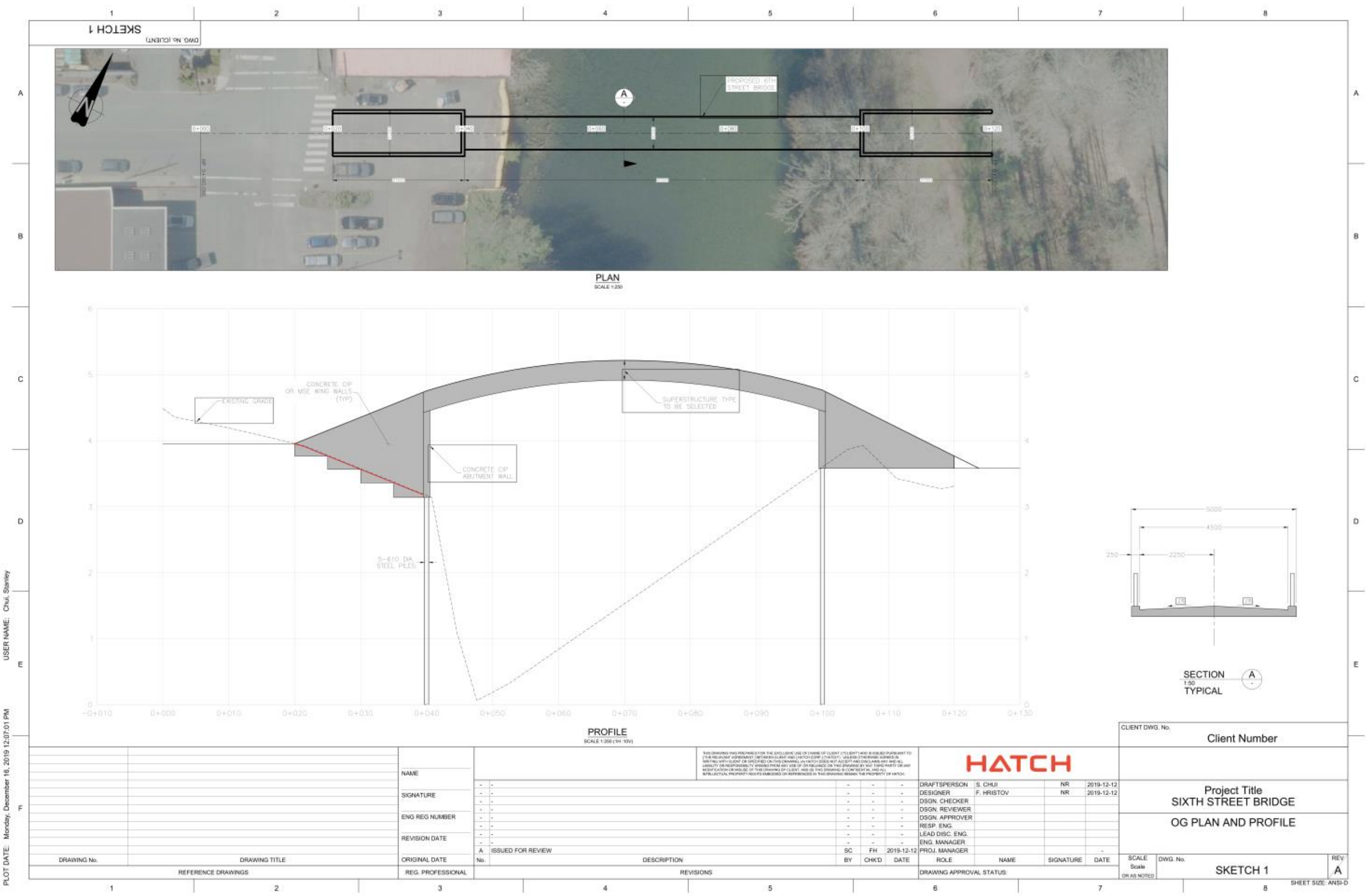


Figure 15: Bridge Embankments and Abutment Concept

4.3 BRIDGE DESIGN CONSIDERATIONS

4.3.1 BRIDGE DECKING

Bridge decking can have significant impacts on the aesthetic and useability of a bridge. The texture or surface material for bridge decking can impact the useability of a bridge for wheeled users especially wheelchairs users. A rough or bumpy surface can be uncomfortable and can have a negative impact on the experience of using the bridge by wheeled users.

The deck options are as follows:

- Heavy pressured treated timber deck similar to that one used for government wharfs

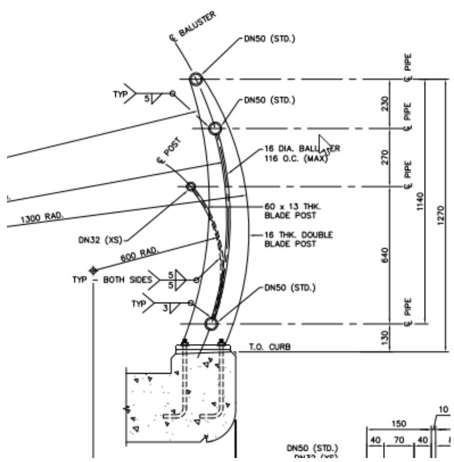
- Concrete deck
- Steel deck covered with epoxy aggregate

While treated timber decking is a potential consideration, we would recommend that it should not be considered as the decking material for the bridge due to comfort use for wheeled users. It would also result in increased maintenance and replacement considerations.

4.3.2 BRIDGE RAILINGS

Like bridge decking, bridge railings can add to the aesthetic value of a bridge. However, bridge railing can also have impacts to the user experience of the bridge. Bridge railings can impede sightlines and certain design features can be unsafe for cyclists or negatively impact those with vision impairments. Careful consideration must be given to the design of the bridge railings to make sure these potential negative impacts are reduced.

Custom made, aesthetically pleasant railings can be designed for the bridge, like the one shown in **Figure 16** below. These types of railing have been considered for the network arch and the cable stay bridge options.



Figures 16: Bridge Railing Option (Example)

The two prefabricated bridge options will be supplied with prefabricated custom steel railings designed specifically for their system. See **Figure 17** and **Figure 18** below for the typical railing systems for Bowstring and Modular bridge systems.

Figure 17: Bowstring Bridge Railing

Figure 18: Modular Bridge Protective Screen System

4.4 OTHER DESIGN CONSIDERATIONS

4.4.1 LIGHTING

Lighting for the bridge can generally be grouped into two types – functional and architectural. Functional lighting provides users on the bridge with the basic level of lighting for safety and useability of the bridge when it is dark outside. Architectural lighting can be used to highlight architectural features of the bridge or improve the overall ambience of the space.

Specific design lighting options have not been developed during this report and can be evaluated during detailed design. We also understand that there are lighting considerations with respect to the river and adjacent natural spaces, and these would also need to be considered. For the purposes of this report allowances have been made for lighting for each bridge option.

4.4.2 WAYFINDING

Wayfinding can be an important tool to help guide pedestrians and cyclists to the key infrastructure and destinations in the City. It is recommended that wayfinding be included in the development of the Sixth Street Multi-Use Bridge that is consistent in design and messaging as with wayfinding throughout the City.

4.4.3 LANDSCAPING

As the bridge will have the opportunity to be a significant structure landscaping around the entrances to the bridge should be considered. While the detail of the landscaping has not been advanced at this time allowances for landscape features have been included in the preliminary costing.

4.4.4 SAFTEY

With all multi-use pathways safety is a consideration for people that walk, people that cycle and all other users. Specific design considerations including pathway curves, signing and pavement markings should be considered during detailed design to ensure a safe experience. Many jurisdictions are currently reviewing safety considerations with respect to E-bikes. While E-bikes are speed restricted by the province, there are currently no specific design guidelines for E-bikes at this time. There are however design considerations that would limit speeds and educate all users on proper E-bike use and assimilation into multi-use pathways. This should be explored further as the project moves into the design phases.

5 CONNECTIVITY CONSIDERATIONS

The key goal of the bridge crossing would be to ensure it is properly integrated into the surrounding walking cycling networks. The proposed bridge provides a better experience than the current condition because they provide a wider pathway and are further separated from cars. They also allow for cyclists to avoid having to share the roadway with vehicles and provide more space for all active users. Beyond the bridge it will be important that this comfort is extended to the various connections to existing and future networks.

The Transportation Master Plan identifies both long-term pedestrian and cycling networks. The long-term cycling plan identifies Sixth Street, Anderton Avenue and the Old Island Highway as proposed cycling corridors. The existing Courtenay Riverway Trail connects to Sixth Street immediately west of Anderton Avenue and would provide a recreational and commuting connection to the south from the proposed multi-use bridge. **Figure 19** shows the key connectivity considerations for the Sixth Street Multi-Use Bridge.

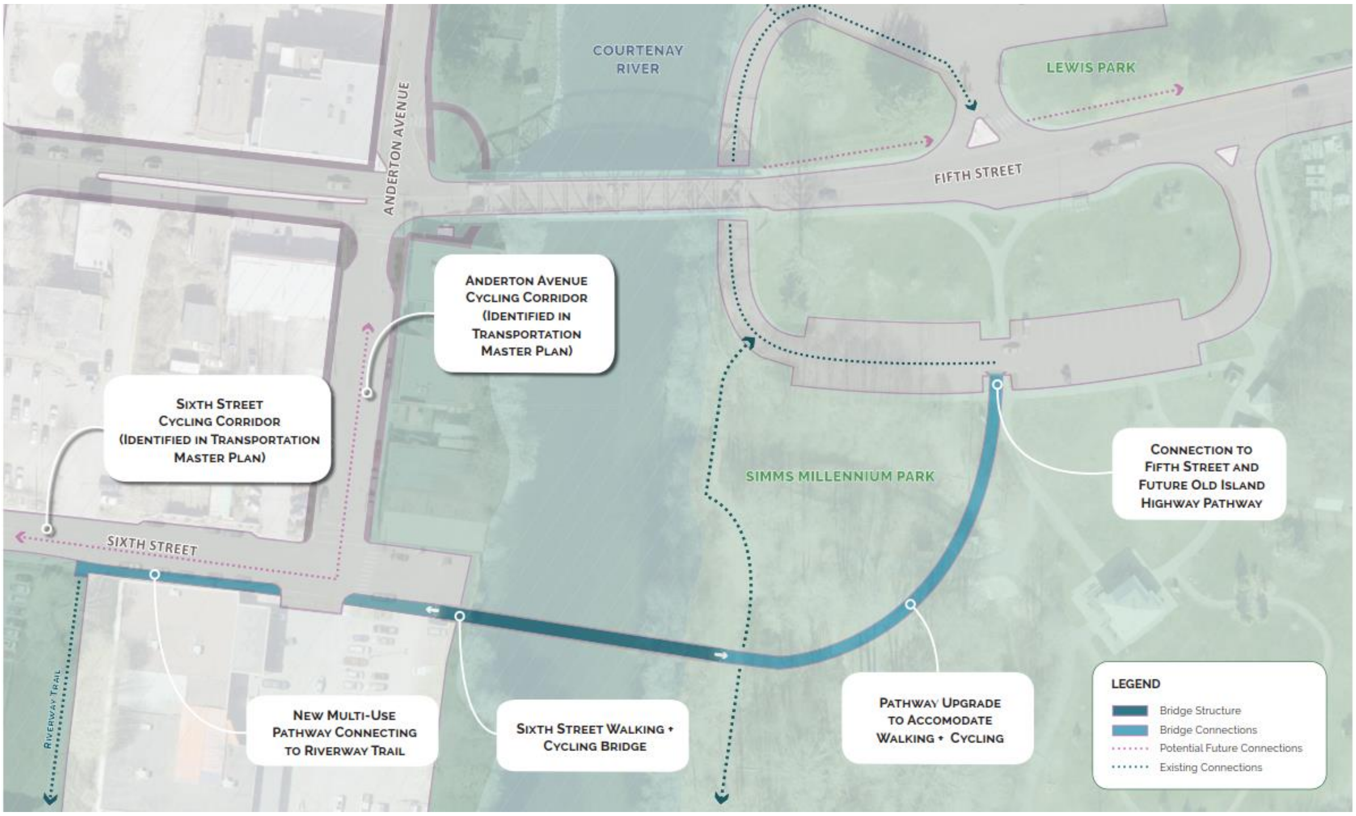


Figure 19: Sixth Street Connectivity Map

5.1.1 KEY CONNECTIONS FOR CONSIDERATION

Old Island Highway Pathway

A pathway is proposed on the north side of the Old Island Highway that provides a direct connection to the Lewis Centre. The Sixth Street bridge connection to this proposed pathway would utilize the existing roadway underpass underneath Fifth Street.

Anderton Avenue

Anderton Avenue provides a north-south connection for pedestrians and cyclists west of the Courtenay River, with connections to the Riverway Trail via Sixth Street. Improvements are required at the Anderton Avenue / Fifth Street intersection to allow for pedestrian and cycling connections across Fifth Street and to maximize the Sixth Street bridge's connectivity to the north end of downtown Courtenay.

Sixth Street

Sixth Street is identified as a cycling route between Anderton Avenue and Fitzgerald Avenue. The bridge design should ensure an efficient connection to the Sixth Street cycling corridor.

Simms Millennium Park

Existing pathways in Simms Millennium Park will need to be upgraded to provide a comfortable connection between the new bridge and the roadway underpass connection to Lewis Park.

Riverway Trail

The Riverway Trail is an existing multi-use trail that extends from Sixth Street to beyond the Comox Valley Parkway. The Sixth Street Multi-Use Bridge would connect to the Riverway Trail via a multi-use pathway along the south side of Sixth Street. This would provide a seamless and safe connection extending the Riverway Trial through to Simms Millennium Park.

Pedestrian Connections

The Sixth Street Multi-Use Bridge will provide a key connection, along with the Fifth Street Bridge, for pedestrians between Simms Millennium Park and Lewis Park and downtown Courtenay.

6 ENVIRONMENTAL AND PERMITTING REVIEW

As the construction work would be conducted above the Courtenay River and within the riparian area, there are a number of environmental considerations including permits and plans that will be required. The three main components will be:

- Preparation of environmental permits – An application will need to be submitted to the BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO) under Section 11 of the Water Sustainability Act for works in and about a stream. In addition, a Request for Review will need to be prepared and submitted to Fisheries and Oceans Canada (DFO). Additionally, a fish collection permit will be required when isolating the work area from the remainder of the Courtenay River.
- Preparation of a Provincial heritage permit - Due to the proximity to the river and the known registered archaeological site within the proposed project area, a Provincial heritage permit (*BC Heritage Conservation Act*) will be required for any excavation work required in and around the proposed bridge. The permit review and approval period is typically in the range of 3 to 6 months. An application for a ground disturbance permit should be submitted as soon as the scope is confirmed, and any potential ground excavation locations are determined.
- Preparation of Environmental Management Plan – The Courtenay River is important habitat for all species of Pacific salmon, steelhead and resident fish species such as rainbow trout, Dolly Varden and cutthroat trout. As such, an Environmental Management Plan (EMP) will be prepared to support the BC Water Sustainability Act and DFO applications. The EMP will provide recommendations and best management practices to minimize the potential for adverse impacts to the Courtenay River as a result of the bridge works.

- Tree Clearing in Simms Park – In order to construct the Sixth Street Multi-Use Bridge, many large trees will be removed from Simms Millennium Park. The tree clearing should take place outside of the nesting period and should consider avoid any culturally or environmentally significant trees if possible.

The EMP and regulatory applications should be completed and submitted once the final scope of work is confirmed. It will be important to ensure any timing windows are understood and the permits can be incorporated into any tender packages. Permit windows can range from 45 days to 6 months depending on the permit and the perceived impact of the project.

7 CONSTRUCTIBILITY CONSIDERATIONS

7.1.1 HOME HARDWARE

There is a building on the northeast corner of the Anderton Avenue / Sixth Street intersection that is currently used by Home Hardware with two garage doors that open onto Sixth Street adjacent to the location of the bridge abutments. Access to this building will need to be reviewed as part of any design.

7.1.2 BRIDGE CLEARANCE

The Sixth Street crossing has been designed with clearance consistent with the Fifth Street Bridge to retain space underneath the bridge for recreational boats and kayaks. It is our understanding that the Courtenay River in this location is not a navigable waterway and large boats are not to be accommodated.

7.1.3 GEOTECHNICAL

A preliminary geotechnical assessment performed by Levelton in 2012 found that ground improvement would be required at both abutments to mitigate displacements. Ground improvements involve installation of a stone columns or vibro replacement points to 10m depth to increase shear strength to reduce soil liquefaction.

7.1.4 TREE IMPACTS

Many trees will be impacted in Millennium Simms Park in order to construct the Sixth Street Multi-Use Bridge. Consideration for minimizing the number of trees to be removed is to be given during detailed design.

7.1.5 LAYDOWN SITES

Several laydown sites have been identified by the City that are within close proximity to the bridge site. These laydown sites can be used to prefabricate the structure of the bridge as required. Using these laydown sites will also prevent trees from being removed from Simms Park due to using it as a laydown site. The City can determine the preferred laydown site during detailed design based on the preferred bridge structure type and timing of construction.

8 COST ESTIMATES

Based on the information provided above **Table 2** provides a summary of the capital costs that would be expected for each bridge option. The costs have been broken down into a number of elements that include both supply and installation of the bridge and associated elements in 2020 dollars. Adjusting these costs into the future should be carefully considered. Costs are highly susceptible to fluctuations in the Canadian dollar, steel costs, other economic factors and the availability of contractors. Escalation costs should be revisited in the future based on the above factors and not just relative inflations values.

Table 2: Capital Cost Estimates

Project Element	Pre-engineered Truss	Modular Panel Bridge	Network Arch Bridge	Cable Stayed Bridge
Construction Duration	4.5 to 6 months	5.5 to 7 months	4.5 to 6 months	5.5 to 7 months
Costs				
Bridge Structure Costs[1]	$0.65 - $0.75 M	$0.8 - $0.935 M	$1.3 - $1.5 M	$1.4 – $1.6 M
Abutments[1]	$1.1 M	$1.1 M	$1.1 M	$1.1 M
Geotechnical Ground Remediation (Allowance)	$0.5 M	$0.5 M	$0.5 M	$0.5 M
Connectivity to Existing Networks[2]	$0.35 M	$0.35 M	$0.35 M	$0.35 M
Engineering and Project Management[3]	$0.4 M	$0.45 M	$0.5 M	$0.55 M

[1] *All bridge structure related costs including structure and abutments include a 15% contingency.*

[2] *Pathway connectivity costs include a 25% contingency.*

[3] *Engineering and Project management estimated at 15% of construction costs.*

Total	**$3 - $3.1 M**	**$3.2 - $3.335 M**	**$3.75 - $3.95 M**	**$3.9 - $4.1 M**

Bridge structure costs include fabrication, delivery and installation of the bridge structure. The connectivity to existing networks cost above includes the costs for constructing a paved multi-use pathway connecting to the Riverway Trail along the south side of Sixth Street and to the parking lot in Simms Millennium Park as shown in the connectivity map (Figure 18). These costs include the necessary tree and civil removals and other civil works required to construct these pathways including signage, lighting and surface markings.

LIFE CYCLE COST CONSIDERATIONS

With any piece of infrastructure life cycle costs are a major consideration. If we consider that all different bridge types use the same deck type and steel type, the only difference in the 20 years lifecycle costs would be the inspection costs.

In general, it could be expected that the bridge options would require painting touch ups every 10 years with a coating replacement needed every 30 years. The network arch bridge and cable stayed bridge would be more costly to coat due to their geometry

The cable stayed bridge will require inspections with specialized equipment to monitor cable conditions. Because of the complexity and height of the tower access to the bridge elements would also be significantly more difficult for this structure.

FUNDING CONSIDERATIONS

There are several funding considerations for the City to consider helping with the costs of the Sixth Street Multi-Use bridge construction. Some potential funding options available are:

- BC Active Transportation Infrastructure Grants Program,
- Federation of Canadian Municipalities (FCM) Grant program,
- Union of BC Municipalities (UBCM) Gas Tax Agreement -Community Works Fund
- Investing in Canada Infrastructure program.

The Province of BC has restructured the BikeBC grant funding to include more active transportation related projects for 2020. The program will still include a yearly intake period with successful applications being notified within a few months of submission. If successful, the Province could provide up to $500,000 cost sharing funds for the project.

The Federation of Canadian Municipalities provides funding options for capital projects that support sustainable transportation network and commuting options. FCM provides low-interest loans and up to 15% grants (of the loan) for infrastructure projects that support transportation project that will help support residents switching to a less polluting form of transportation. The City has also recently applied to the FCM Green Municipal Fund for a grant that would cover much of the cost of the feasibility study to review these bridge options. We understand that the FCM is currently reviewing and considering the application.

Federal funds are available through the renewed Gas Tax Agreement. The UBCM allocates funding to municipalities each year and the City can include this project on their list to help with the construction costs.

The Investing in Canada Infrastructure program provides grants for infrastructure projects throughout Canada. The program is currently closed for intake but could be reopened in the future and should be considered.

9 OPTION EVALUATION

9.1 EVALUATION CRITERIA

Each bridge option is being evaluated against various criteria to help understand a preferred crossing option. The following criteria are the basis for the evaluation:

- Aesthetic Value
- Pedestrian / Cyclist Comfort / Experience
- Environmental Impact
- Constructability Considerations
- Capital Cost
- Lifecycle Considerations (operations and maintenance)

9.2 EVALUATION RESULTS

The evaluation matrix is provided below in **Table 3** below.

Table 3: Evaluation Matrix Summary

	Pre-engineered Pedestrian Truss Bridge (Bowstring)		Modular Panel Bridge		Network Arch Bridge		Cable Stayed Bridge	
Aesthetic Value	Convention structure with truss systems	3	Convention structure with truss systems. Typically used for temporary structures.	1	Signature Structure	4	Signature Structure	5
Pedestrian / Cyclist Comfort / Experience	Comfortable with smooth decking and safe railing design. Design grade at or below 4%.	4	Semi comfortable with smooth steel decking and safe railing design. Design grade at or below 4%.	3	Comfortable with smooth decking and safe railing design. Design grade at or below 4%.	4	Proposed wood decking would be uncomfortable for wheeled users and others with mobility challenges. Design grade at or below 4%.	2
Environmental Impact	Minimal. Mitigation methods can be implemented.	3	Minimal. Mitigation methods can be implemented.	3	Minimal. Mitigation methods can be implemented.	3	Minimal. Mitigation methods can be implemented. Additional tree clearing required on the east side due to the need for concrete anchor system.	2
Constructability Considerations	Constructing the bridge during colder months would cost more due to heating and conditioning of contained workspace. Significant laydown space required.	3	Constructing the bridge during colder months would cost more due to heating and conditioning of contained workspace. Significant laydown space required.	3	Constructing the bridge during colder months would cost more due to heating and conditioning of contained workspace. Significant laydown space required.	3	Higher construction risks for this bridge option because of its complexity.	2
Capital Cost	$$	4	$$	4	$$$	2	$$$$	1
Lifecycle Considerations (operations and maintenance)	Minimal First maintenance touch-up painting at 10 years Full overcoat of structure at thirty years	3	Minimal maintenance required. Temporary structure that won't last as long as a standard bridge.	3	Increased future inspection & maintenance efforts First maintenance touch-up painting at 10 years Full overcoat of structure at thirty years	2	Increased future inspection & maintenance efforts Special equipment is required for tall bridge tower and cable inspections	1
Total Score	**20**		**17**		**18**		**13**	

10 RECOMMENDATION

Based on the criteria presented above and the conducted evaluation, if the City were to advance the Sixth Street Multi-Use bridge, the recommended bridge design is the Pre-Engineered Bowstring Truss Bridge. While slightly less aesthetically pleasing, the bowstring truss bridge would provide the City with an economical choice while still meeting the functional requirements of active transportation users of the bridge.

If a ‘signature” structure is more desirable a network arch would provide this, but it would come at a slightly higher capital cost and with greater maintenance considerations.

11 NEXT STEPS

The following are the recommended next steps for the Sixth Street Bridge:

1. Present this report to Council to confirm direction;
2. Research funding opportunities and start preparation of applications for applicable funding applications; and
3. Prepare a preliminary and detail design of a Sixth Street Multi-Use Bridge, if approved by Council to proceed.