Johnson Street Bridges

Johnson Street Bridge Project |Technical Evaluation of Replacement and Rehabilitation Alternatives

June 2010

Prepared by:

MMM GROUP

STANDARD LIMITATIONS

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A5. Advicas, Class “C” Estimate, Johnson Street Bridges Replacement/Rehabilitation, Victoria, BC, June 9, 2010.

A6. Wilkinson Eyre Architects, Renderings & Drawings for Replacement Alternative, May 28, 2010

A7. Wilkinson Eyre Architects, Renderings & Drawings for Rehabilitation Alternative, May 28, 2010.

A8. MMM Group Limited, Letter for Traffic Study on East Side of Bridge, June 11, 2010.

APPENDIX B – Reference Documents

B1. Paper read before the Victoria Branch, The Engineering Institute of Canada, February 27, 1924.

B2. Robert Freundlich & Associates Ltd., City of Victoria Johnson Street Bridge Electrical/Mechanical Condition Report, March 1990.

B3. Graeme & Murray, City of Victoria Johnson Street Bridge Structural Condition Report, August 1990. Contains B.H. Levelton & Associates “Paint Evaluation Johnson Street/Bay Bridges” dated May 17, 1990 and Ocean Marine “Underwater Inspection Report by Ocean Marine”.

B4. Graeme & Murray, Johnson Street Bridge Condition Report, April 9, 1998.

B5. Graeme & Murray, New Cycling and Pedestrian Walkway Feasibility Report, January 2000 and revised April 20, 2000.

B6. Delcan, Johnson Street Bridge Condition Assessment Report, 2009.

B7. Commonwealth Historic Resource Management Limited, Heritage Assessment of the Johnson Street Bridge, Victoria, April 2009.

B8. Stantec, Johnson Street Bridge Replacement Project Geotechnical Investigation, September 2009.

1. INTRODUCTION

In March 2010 MMM Group was requested by the City of Victoria to examine and compare two basic options for the Johnson Street Bridge:

Replacement - Replacement of the existing bridges with a new bascule bridge designed to prevent collapse in a M8.5 seismic event and be integrated with the existing and proposed site features.

Rehabilitation - Rehabilitation and seismic upgrade of the existing bridges and construction of a new separate multi-use trail pedestrian bridge. The seismic upgrade would be undertaken to prevent collapse after an M8.5 seismic event.

Engineering studies and design were developed for both alternatives in order to establish Class “C” cost estimates. Estimates were prepared using professional quantity surveyors and independent of any estimating carried out previously.

Both alternatives were evaluated and compared based on scope, heritage impact, cost, schedule, life cycle costs and economic impact. The estimated costs were compared with existing estimates. Potential scope reductions for both alternatives were explored.

This report summarizes the engineering, architectural and other technical work provided in the attached “A” series appendices. The “B” series appendices, also attached, are a compilation of reference materials collected and consulted as part of this study.

2. GENERAL CONSIDERATIONS

2.1 Project Objectives

The following project objectives were established based on discussions with the City and the Citizen’s Advisory Panel:

- Replace or rehabilitate the Johnson Street Bridge to provide safe and durable infrastructure;
- Provide for a traffic-calmed corridor through the project site;
- Provision of 2 westbound and 1 eastbound lanes of traffic;
- Provision of dedicated sidewalk for pedestrians on the south side;
- Provision of dedicated crossing for rail;

- Provision of dedicated multi-use path crossing with a 5 m width on the north side;
- Provision of on-street bike lanes;
- Design to a life line standard (see **Table 2.1**, non-collapse after an equivalent M 8.5 seismic event);
- Design in accordance with CSA-S6-06, "Standards and Guidelines for the Conservation of Historic Places in Canada", "City of Victoria Old Town Guidelines" and other City standards;
- Provide a 100 year service life for new and rehabilitated structures;
- Provide for a navigation channel that is in accordance with today's standards as set out by the Navigable Waters Protection Act;
- Design for improved accessibility for all modes at the bridge heads;
- Integration of the bridge sidewalk with the proposed Harbour Pathway and the Songhees Walkway; and
- Maintenance of vehicular, marine and cyclist/pedestrian traffic during construction.

2.2 Seismic Considerations

Victoria is located in the most active seismic zone in Canada and one of the most active seismic zones in North America. For example recent studies have indicated that there is a 35% probability of a major earthquake (M7.5) occurring in Victoria in the next 50 years. Major earthquakes in the vicinity of Victoria have made headlines including the 2001 M6.8 Nisqually earthquake in Washington State.

The Point Ellice Bridge was seismically strengthened in 2001 to avoid collapse in a M6.5 earthquake. At the time, this was the most stringent design criteria for seismic retrofits. According to the 2009 Condition report (see **Appendix B6**), the existing Johnson Street bridges will likely collapse in an earthquake with a magnitude less than M6.5. As such, there will be virtually no emergency access across the Upper Harbour after a major earthquake.

In addition to emergency access, the selection of appropriate seismic performance is typically based on consideration of the following:

- Life safety;
- Protection of the investment made in a facility;
- Post-disaster economic recovery.

With regard to seismic performance, the following definitions have been used to provide a point of reference for non-technical readers:

- Magnitude 6.5 (M6.5) on the Richter Scale – rough equivalence to the design earthquake with a 10% probability in 50 years;
- Magnitude 8.5 (M8.5) on the Richter Scale – rough equivalence to the design earthquake with a 2% probability in 50 years.

With reference to the above, seismic performance criteria that have been considered in this study are:

Table 2.1 – Seismic Performance Criteria

Seismic Design Category	Performance	
	After M6.5 Earthquake	After M8.5 Earthquake
Lifeline	No damage	No collapse Repair needed
Other	No collapse Repair needed	Replacement needed

MMM was requested to identify costs for both the M6.5 and M8.5 earthquake equivalent and these costs are presented in this report. Given the importance of the structure in the post earthquake transportation network and the magnitude of public investment that might be lost if collapse occurred, and public safety during an earthquake, design of the bridge to a Lifeline level design is recommended for either the replacement or the rehabilitation options.

The most recent version of the AASHTO design code has been used to establish seismic retrofit requirements. This design code represents the North American industry standard for seismic engineering. AASHTO uses different designations than those noted above in **Table 2.1**. The seismic analysis work presented in **Appendix A4** was carried out for an earthquake with a risk profile between the two noted above and the results of this analysis were then scaled up and down to represent the M6.5 and M8.5 events noted above.

2.3 Railway Considerations

A dedicated rail crossing with a station on the downtown side of the crossing has been included in the base scope for both the replacement and the rehabilitation options. There is considerable cost associated with providing this service. By terminating the rail service on the Victoria West side of the crossing, savings can be realized as follows:

- Replacement option – the width of bridge deck could be reduced by at least 5 m resulting in savings corresponding to reduced structural steel, substructure concrete, foundations and electrical/mechanical demands. Savings would also be realized over the life of the bridge with regard to reduced operations and maintenance costs;
- Rehabilitation option – the railway bridge could be converted to a multi-use trail bridge thus eliminating the need for and cost of a separate, new trail bridge.

The City has noted that, if the rail crossing is discontinued, provision for a future rail corridor will be maintained in the development of all design work.

2.4 Roadway Considerations

Three lanes of traffic are provided in the base scope of both options – one eastbound lane and two westbound lanes. MMM was requested to report on the feasibility and implications associated with reducing the number of lanes across the rehabilitated bridge to two – one in each direction, and the addition of 1.5 m on-street cycling lanes for each direction. The implications of such a change are as follows:

- Reduction in the number of lanes may help with providing on-street bike lanes in the Rehabilitation option but would not result in any cost reductions for this option.
- Reduction in the number of lanes will result in an increase in queue lengths on the downtown side of the bridge for westbound traffic. In particular queues will extend along Warf Street beyond Yates Street effectively blocking that intersection. Queues on Pandora Street will extend nearly to Government Street. Traffic at the end of the queue will not clear the signalized intersections on one signal cycle and therefore will experience level of service (LOS) F conditions based on 2009 traffic volumes. As trip volumes grow (all modes) the congestion will increase resulting in gridlock during the afternoon peak hour.
- Increased queuing will increase greenhouse gas emissions.

- Lane reductions and queuing will result in increased emergency response time, which is a concern of emergency providers.
- Lane reductions will result in a doubling (or more) of the vehicle traffic clearance time when the bridge is opened for marine traffic.
- Although the traffic analysis presented in Appendix A8 reflect 2009 volumes, it is recognized that trip growth of at least 40% is expected by 2026 in accordance with the Regional Growth Strategy and Travel Choices. This will make the predicted congestion more pronounced.

An analysis of a two lane scenario is provided in **Appendix A8**.

3. REPLACEMENT OPTION

3.1 Scope

The scope of the rehabilitation option includes:

- Realignment of the approach roads to eliminate the "S" curve and eliminate pedestrian/cyclist/ vehicular conflicts at the east bridge head;
- Installation of traffic signals at the Harbour Road/Esquimalt Intersection;
- Design of landscape and urban design features to provide a traffic-calmed corridor through the project site;
- Construction of a new bascule bridge with approaches to the north of the existing bridges with a single bridge deck to carry the 5 m multi-use trail, 3 – 3 m lanes of traffic, 2-1,8 m wide on-street bike lanes, a 5 m wide rail corridor and a 2.5 m wide pedestrian sidewalk;
- Design of the new bridge for non-collapse after a M8.5 seismic event;
- Increase of the navigation channel width to meet the requirements of the Navigable Waters Act;
- Integration of the pedestrian sidewalk on the new bridge with the Songhees Walkway and the proposed Harbour Pathway;
- Design in accordance with current Accessibility requirements;
- New approaches for the Galloping Goose Trail on the east and west designed to current cyclist standards;
- Connection to the proposed Esquimalt Trail at the west side of the bridge by way of a cyclist/pedestrian overpass structure;
- Provision of a new VIA Rail station with improved parking on the downtown side; and

► Decommissioning of the existing bridges.

The scope of the replacement option is illustrated in **Figures 3.1, 3.2 and 3.3**. Additional details of the replacement option are provided in **Appendix A6**.

Figure 3.1 – Cross Section of Replacement Option.

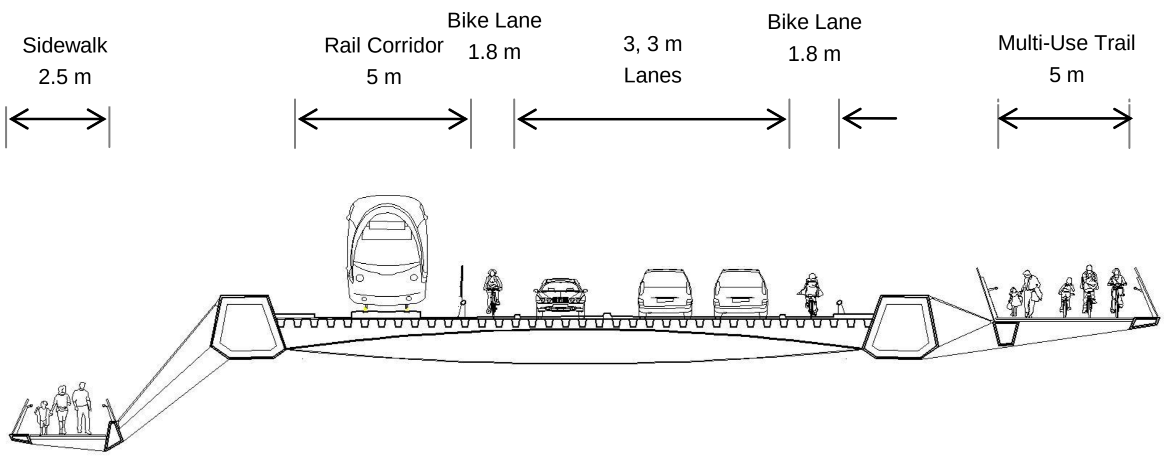


Figure 3.2 – Replacement Option (Looking South towards Inner Harbour).

Figure 3.3 – Replacement Option (Looking West from Downtown).

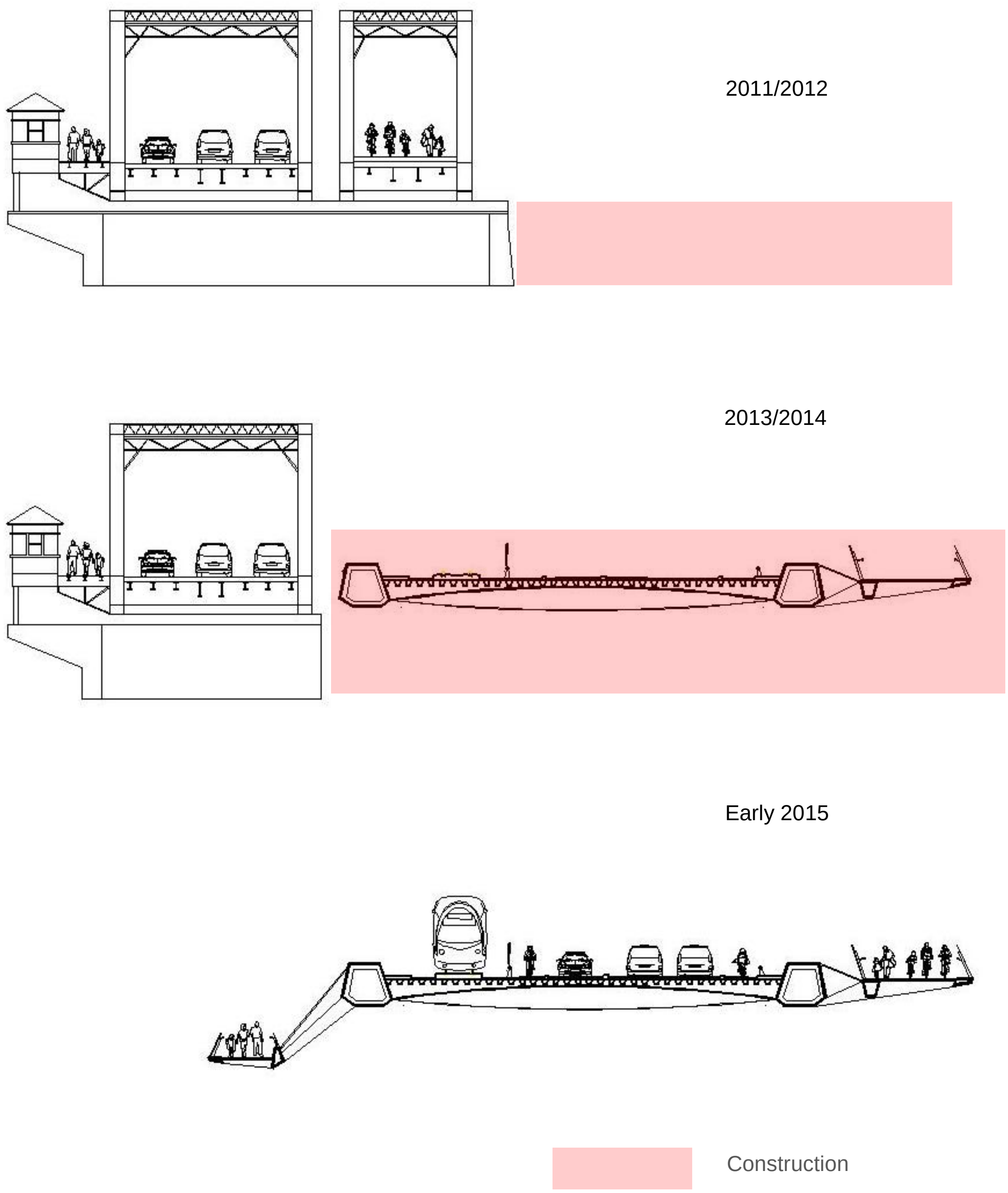
3.2 Project Schedule and Staging

A replacement bridge would require four years to complete with decommissioning of the existing road bridge in the fifth year. This schedule assumes a traditional design-bid-build approach. An outline of the project schedule is provided in **Table 3.1** with the corresponding construction staging presented in **Figure 3.4.**

Table 3.1 – Project Schedule for Replacement Bridge

Year	Activity
2011	Design and Tendering
2012	Fabrication of long lead time items, temporary relocation of the VIA Rail Station to the west of the site, removal of rail bridge and associated foundations, other site preparatory work, approach roads, bridge foundations
2013 to 2014	Completion of bridge foundations, piers and abutments, superstructure, install electrical/mechanical equipment, road tie-in's.
Early 2015	Decommissioning of Existing Bridges, New bridge open

Figure 3.4 – Staging of Replacement Construction.



3.3 Heritage Considerations

The replacement bridge design was developed in the context of the City's Old Town Design Guidelines as well as with respect to the historic nature of the site. The new bridge design was developed to provide view corridors of the old town, the Upper Harbour and Inner Harbor that are currently blocked by the existing bridge superstructure and counterweights. The design of the new bridge reflects the truss and heavy construction of traditional railway bridges and as such provides a memory of this important historical element of the site while providing for a new, modern design. Detailed heritage considerations are provided in **Appendix A1**.

3.4 Estimated Costs

Based on the seismic, structural and electrical/mechanical engineering design carried out by MMM in late 2009, quantities and construction work processes were developed to allow estimation of costs. Costs were adjusted to reflect a four year construction program. The estimated cost of this alternative is $89 million, excluding costs associated with future repairs/maintenance, legal fees, triple bottom line considerations and City administration. Details of the cost estimate are provided in **Appendix A5**. Note that in **Appendix A5** costs associated with property, project financing and taxes are not included. These additional costs are estimated to be $4 million.

Table 3.2 provides a summary of the estimated costs as well as a comparison with the 2008 estimate.

Table 3.2 – Comparison Between Current and Previous Cost Estimates for Replacement Bridge.

Cost Item	Estimated Costs ($ millions)		
	2008 Estimate	2010 Class "C" Estimate	Difference
Construction Items *			
General Conditions	1	3	+2
Demolition of Existing Bridges	3	3	0
Bridge	44	48	+4
Roads/Civil Works/Illumination	5	6	+1
Subtotal Construction	53	60	+7
Contingency (15%)	4	9	+5
Engineering (12%)	6	8	+2
Property	0	1	+1
Escalation, Financing, Taxes	0	11	+11

Table 3.2 – Comparison Between Current and Previous Cost Estimates for Replacement Bridge.

Cost Item	Estimated Costs ($ millions)		
	2008 Estimate	2010 Class "C" Estimate	Difference
Total Estimated Cost	63	89	+26

*General conditions provided in the detailed cost estimates presented in **Appendix A5** have been distributed over other construction items to reflect anticipated bid numbers.

The key differences between the current cost estimate and the previous estimate are as follows:

- Construction costs were increased to reflect the complexity of the project, the iconic nature of the replacement bridge and the limited number of general contractors with experience in building moveable bridges;
- The construction contingency was increased to15% to reflect the complexity of the project as well as uncertainty with regard to market conditions for construction over the next five years;
- The previous estimate did not include sufficient provision for items such as Public Art, relocation of the Telus duct, disposal of contaminated soils and other miscellaneous items;
- Property costs were not previously included.
- $19 million of the $26 million cost increase is due to delay and includes escalation, financing and contingencies.
- $7 million of the $26 million cost increase is due to the increased complexity of the project.

Life cycle costs were developed using the assumptions given in **Table 3.3**. A life cycle cost of $ 22 million ($2010) was established. When discounted over 100 years with a rate of 3.5%, the life cycle cost becomes $4 million.

Table 3.3 – Life Cycle Cost Considerations.

Activity	Frequency	Start Year	Cost per Occurrence ($,000's)
Annual Maintenance	annually	5	25
Engineering Inspections	bi-annual	5	10
Paint Touch-Up	10 years	15	25
Electrical Mechanical Repairs	one time	55	2,000
Repaint	20 years	25	4,000
Repave	15 years	20	250

3.5 Economic Impact

Construction of a replacement bridge will require minimal lane closures on the existing bridge as illustrated in **Figure 3.4**. This is not expected to result in any significant negative economic impact in terms of business loss, user delay costs and a bus diversion costs.

3.6 Potential Cost Reductions

The replacement option was examined for potential cost reductions. Scope reductions were applied with corresponding cost reductions to achieve a minimal scope option. Reduction in the number of lanes from 3 to 2 was not included in this exercise. The minimum scope option is provided in **Table 3.4**.

Table 3.4 – Minimum Scope Replacement Option

Scope	Cost ($ millions)	Comment
Base Scope	89	
Potential Scope Reductions		
Delete rail related components	-12	Reduce deck width, foundations and related infrastructure of proposed replacement design.
Reduce Seismic To M6.5 Earthquake (Not Recommended)	-10	Not recommended
Reduced Project Estimate	77	Based on M8.5 earthquake

If the rail component is deferred, the cost of implementing in the future will be at least double and perhaps triple the realized savings (i.e. $24 to $36 million). This increase in cost reflects the fact that considerable cost efficiencies would be available if the rail component is incorporated into the overall replacement bridge. Efficiencies in this regard would include shared foundations and substructures, shared electrical/mechanical equipment and shared costs for mobilization and site overhead. These efficiencies would be lost if the rail bridge was delivered as a future, standalone project.

4. REHABILITATION OPTION

4.1 Scope

The scope of the Rehabilitation Option includes:

- Construction of a new 5 m wide multi-use trail bridge north of the existing rail bridge;
- Replacement of the existing 85 year old electrical and mechanical equipment with all new components including links, trunnions, gears, motors, rack and signals;
- Seismic strengthening to allow for no collapse in a M8.5 seismic event; This strengthening would include installation of 8 - 2.4m diameter drilled shafts to support the counterweight tower, stabilization of the rest pier and abutments using rock anchors, addition of energy dissipating bracing in the bridge superstructures and the localized strengthening of various truss members;
- Repair of corroded structural steel and rivets;
- Removal of existing lead based paint system and replacement with a new 3 coat paint system;
- Replacement of the existing open grating deck on the existing road bridge with a new surface that is more suitable for on-street cyclists;
- Replacement of the existing open grating deck on the bridge sidewalk with a new surface that is more suitable for pedestrians;
- New fendering to provide ship impact protection;
- Reconfiguration of the sidewalks along Wharf Street at the east approach to the bridge; and
- New roadway signage.

A number of project requirements could not be achieved with the rehabilitation option. These are:

- On-street biking cannot be provided under the existing rail overpass over the west approach road or over the bridge due to space restrictions (see **Appendix A8**). Discontinuous cyclist lanes through the project are not recommended and as such dedicated on-street bike lanes are not provided over the existing road bridge when rehabilitated.
- A direct connection to the Harbour Pathway and Songhees Walkway has not been achieved.

It is important to note that the scope of the repairs required to address corroded steel is extremely difficult to establish and that the scope of these steel repairs will not be fully known until the existing paint system has been grit blasted off during construction. As such there is an inherent risk with the rehabilitation option with regard to scope, cost and schedule.

The scope of the rehabilitation option is illustrated in **Figures 4.1, 4.2 and 4.3**. Additional details of the rehabilitation option are provided in **Appendix A7**. Details of the technical considerations used to develop this option are provided in **Appendices A2, A3**, and **A4**.

Figure 4.1- Section through Rehabilitation Option.

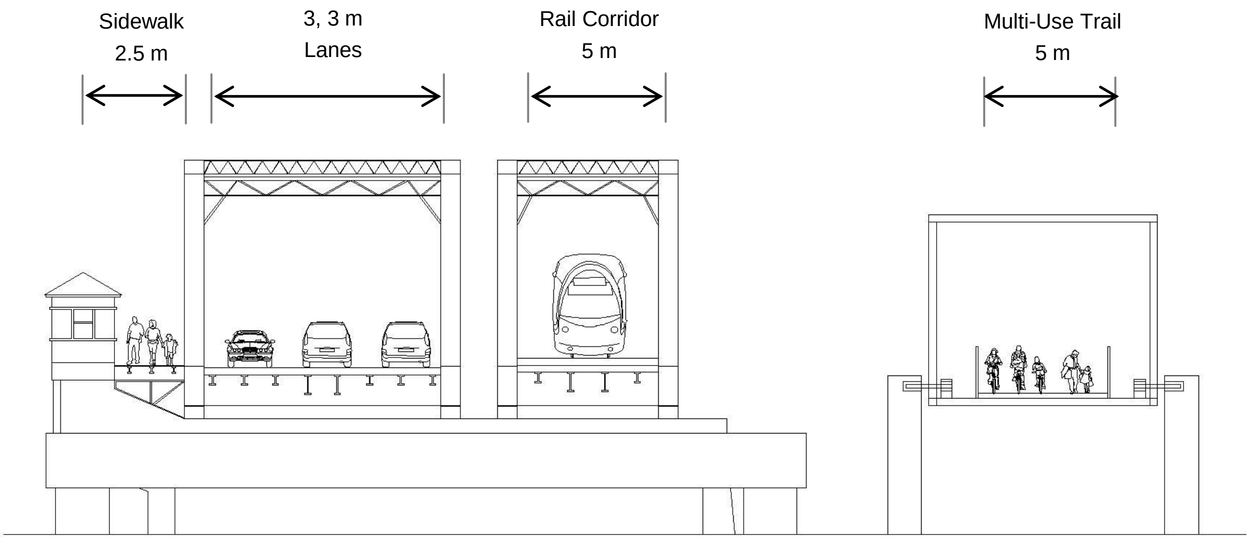


Figure 4.2 – Rehabilitation Option (Looking South towards Inner Harbour).

Figure 4.3 – Rehabilitation Option (Looking West from Downtown).

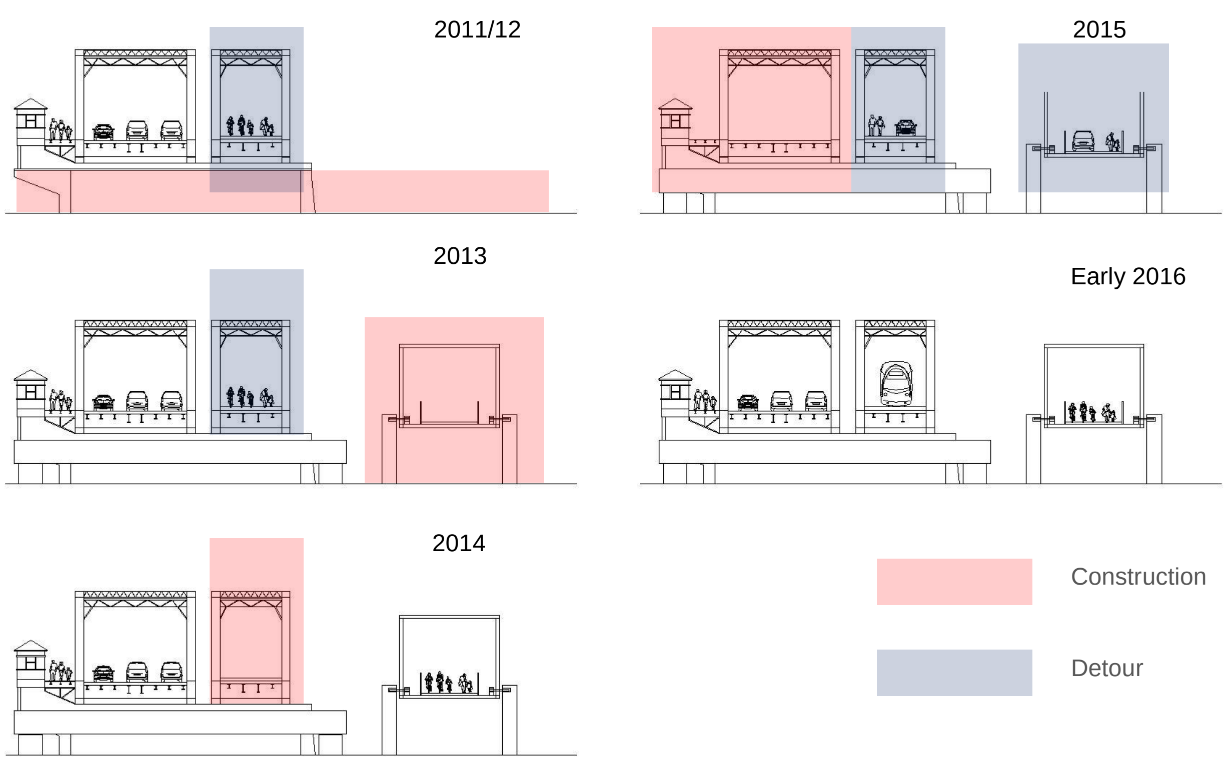
4.2 Project Schedule and Staging

Rehabilitation would require five years to complete. An outline of the project schedule is provided in **Table 4.1** and the corresponding staging is illustrated in **Figure 4.4.**

Table 4.1 – Project Schedule for Rehabilitation Option

Year	Activity
2011	Design and Tendering
2012	Fabrication of long lead time items, temporary relocation of the VIA Rail Station to the west of the site and other site preparatory work, initiation of foundation works.
2013	Construct new Multi-use Trail Bridge, Seismic Retrofit of existing bridge foundations/substructures
2014	Rehabilitation of Railway Bridge
2015	Rehabilitation of Road Bridge
Early 2016	Completion of Construction

Figure 4.4 – Staging of Construction for Rehabilitation Option



In reviewing staging options for this option it was concluded that rehabilitation is not practical while the bridges are kept operational. The reasons for this conclusion are as follows:

- Painting will require full enclosure of each bridge including provision of a negative pressure containment system to prevent lead based paint from escaping into the atmosphere. The complexity of the installation of this enclosure will be greatly increased if the bridge needs to remain operational to marine traffic.
- Given that the existing road bridge is relatively narrow, painting of the existing trusses adjacent to traffic introduces a risk that private vehicles may be damaged during construction. This risk could increase the cost of the project.
- Replacement of the electrical/mechanical components will require dismantling much of the existing bridges. This will not be feasible if the bridges are operational.

As such, full possession of each bridge is required to affect the proposed rehabilitation. To avoid significant economic impacts associated with closing the crossing to vehicular traffic for a prolonged period of time, a staging plan has been developed in which at least two lanes of traffic are kept operational.

Consideration was also given to undertaking work during night closures to minimize construction-related traffic impacts. Night work was found to be inefficient and would consequently increase the cost of the work and as such not considered to be practical.

Construction impacts associated with the staging illustrated in **Figure 4.4** include:

- Traffic would be detoured over the existing rail bridge (eastbound) and the new multi-use trail bridge (westbound) for one year while the road bridge is rehabilitated. As such traffic would be limited to 2-lanes for one year with the corresponding economic impacts;
- Accommodation of transit buses on the multi-use trail bridge detour should be considered if the cost of overbuilding the multi-use trail bridge for bus loads is found to be less than the economic impact on the transit system resulting from buses being detoured to the Point Ellice Bridge; and
- Pedestrian and bike access will be reduced during construction.

To maintain use of the navigation channel, the bascule spans of the existing bridges need to be disconnected from the counterweight tower and removed from site to affect the necessary paint removal and steel repairs. These spans would be re-instated after completion of the repairs and re-painting. Alternatively, these spans could be rehabilitated in the open position.

4.3 Heritage Considerations

Given the historical significance of the project site as well as the bridge, the design proposed for the rehabilitation and multi-use trail bridge were reviewed from a heritage conservation perspective. In general, the proposed interventions to the existing bridges were considered to be acceptable – subject to review of detailed design. The design of the proposed multi-use trail bridge was considered to be satisfactory but possibly not clearly differentiable from the historic fabric of the site, therefore further consideration is required during detailed design if this option is chosen. Detailed heritage considerations are provided in **Appendix A1**.

4.4 Estimated Costs

Based on the seismic, structural and electrical/mechanical engineering design carried out for this study, quantities and construction work processes were developed to allow estimation of costs. Costs were adjusted to reflect a five year rehabilitation program with an end-2015 completion date. The estimated cost is $103 million, excluding costs associated with future repairs/maintenance, legal fees, triple bottom line considerations and City administration. Details of this cost are provided in **Appendix A5**. Note that in **Appendix A5** costs associated with property, project financing and taxes are not included. These additional costs are estimated to be $5 million. A summary of the estimated cost is provided in **Table 4.2**.

Table 4.2 – Cost Estimate for Rehabilitation Option

Cost Item	2010 Class "C" Estimate ($ millions)
Construction Items *	
Mobilization, site preparation, traffic management	4
Structural (including painting)	25
Electrical/mechanical	14
New multi-use trail bridge	13
Multi-use trail paths and trail head	3
Detours	3
Subtotal construction (25% on rehabilitation, 15% on new construction)	62
Contingency	14
Engineering	13
Property	1
Escalation, Financing, Taxes	13
Total Estimated Cost	103

*General conditions provided in the detailed cost estimates presented in Appendix A5 have been distributed over other construction items to reflect anticipated bid numbers

Life cycle costs were developed using the assumptions given in **Table 4.3**. A life cycle cost of $ 48 million ($2010) was established. When discounted over 100 years with a rate of 3.5%, the life cycle cost is $12 million.

Table 4.3 – Life Cycle Cost Considerations.

Activity	Frequency	Start year	Cost per Occurrence ($,000's)
All Bridges			
Annual Maintenance	annually	5	50
Engineering Inspections	bi-annual	5	10
Existing Bridges			
Paint Touch-Up and Minor Steel Repairs	5 years	10	50
Repairs to wearing surface	5 years	10	25
Electrical Mechanical Repairs	once	55	2,000
Repaint and Steel Repairs	15 years	20	6,000
Approach Span deck replacement	once	20	2,500
Wearing Surface Replacement	15 years	20	250
New Multi-Use Trail Bridge			
Paint Touch-Up	10 years	15	10
Electrical Mechanical Repairs	one time	55	3,000
Repaint	20 years	25	1,000

4.5 Economic Impact

Rehabilitation will require lane restrictions as illustrated in **Figure 4.4**. If the reduced scope option described above is adopted a 12 month full closure of both bridges is anticipated. The economic impact of these lanes restrictions and closures is as follows:

- Two lanes open for 12 months (Likely to occur for one year with base rehabilitation option):
  - Business disruption - $2.6 million;
  - Driver / passenger travel time - $04 million;
  - Bus diversion Costs - $1.5 million; and
  - Total - $4.5 million >
- Full closure 12 months (Not Recommended with Any Option):
  - Business disruption - $10.3 million;
  - Driver / passenger travel time - $1.6 million;
  - Bus diversion costs - $1.5 million; and

- Total - $13.4 million.

Details of these economic impacts are provided in a separate report prepared by Banjar Management Inc.

4.6 Potential Cost Reductions

The replacement option was examined for potential cost reductions. Scope reductions were applied with corresponding cost reductions to achieve a minimal scope option. Reduction in the number of lanes from 3 to 2 was not included in this exercise. The minimum scope option is provided in **Table 4.4**.

Table 4.4 – Minimum Scope Option for Rehabilitation

Scope	Cost ($ millions)	Comment
Base Scope	103	
Potential Scope Reductions		
Delete multi-use trail bridge and detours but retain trail head improvements on downtown and Victoria West sides (will require full closure for 12 months)	-25	Rail bridge would be required to maintain multi-use trail and for single lane traffic during construction. Rail service terminated west of the existing bridges. This will require the existing deck on the existing Railway Bridge to be replaced to accommodate cyclists.
Reduce Seismic To M6.5 Earthquake (Not Recommended)	-15	Not Recommended
Reduced Scope Option Cost	80	Based on M8.5 earthquake

5. COMPARISON OF OPTIONS

Based on the analysis provided above and in **Appendices A1** to **A8**, the following comparisons can be made between the replacement and rehabilitation options with regard to meeting of project objectives:

Table 5.1 –Comparison of Options.

Project Objective	Replacement	Rehabilitation
100 year service life	Y	Y
M8.5 seismic performance	Y	Y
Heritage conservation– existing bridge structure	N	Y
Heritage conservation – site	Y	Y

Table 5.1 –Comparison of Options.

Project Objective	Replacement	Rehabilitation
Dedicated multi-use path	Y	Y
On-street bike lanes	Y	N
Dedicated rail crossing	Y	Y
3 lanes for vehicles	Y	Y
Dedicated sidewalk	Y	Y
Eliminate "S" curve	Y	N
Integration with existing and proposed pathways	Y	Partial
Traffic calming	Y	Y
Upgraded navigation channel	Y	N
Consolidation of existing green space	Y	N

From a cost perspective the two options compare as follows:

Table 5.2 – Cost Comparison of Options.

	Replacement	Rehabilitation
Full Scope		
Full Scope, Total Project Cost	89	103
Life cycle cost in $2010	22	48
Present value of life cycle costs	4	12
Schedule with full scope	4 years	5 years
Economic impact with full scope	N/A	5
Reduced Scope		
Reduced Scope, Total Project Cost	77	80
Life cycle costs in $2010	22	42
Present value of life cycle costs	4	11
Schedule with reduced scope	4 Years	4 Years
Economic impact with reduced scope	N/A	13

It is noted that the 2009 Condition Report (**Appendix B6**) recommends that the City address the seismic and condition issues raised in the report by 2012. We believe that these recommendations are prudent and support them.