

APPENDIX G

BRIDGE ASSESSMENT



BF 73649 E/W Bridge Culverts Highway 15 Crossing Astotin Creek

Bridge Culvert Assessment Report

The following report has been prepared by CIMA+ for the exclusive use of Strathcona County. It has been prepared in accordance with the "Engineering Consultant Guidelines for Highway and Bridge Projects". Recommendations presented herein are based on the site survey findings within the defined scope of work.

Prepared by :

Miranda Rowda, P.Eng
Bridge Engineer

PROJECT N° E025 E00311A
November 26, 2012

1.0 INTRODUCTION

CIMA+ has been retained by the County of Strathcona to complete the functional planning for Highway 15:06. The assessments of Bridge Files (BF) 73649E and BF 73649W were initiated as part of this study. The purpose of this assessment is to evaluate the condition of the existing structures and to determine an appropriate long term strategy within the context of the functional planning study.

The scope of this report is summarized as follows:

- Review of existing bridge data,
- Confirm and report on the results of the most recent inspections of the structures,
- Review the controlling factors including structural condition, hydrotechnical, geotechnical, environmental, geometrics, traffic usage and future development,
- Provide bridge management strategies for repairs or replacement as required,
- Recommend a bridge strategy that provides the County with a feasible solution for this site within the context of the functional planning study.

2.0 BF 73649E

2.1 BRIDGE CULVERT DESCRIPTION

This bridge file is located along Highway 15 crossing Astotin Creek. BF 73649E is located under the Highway 15 east bound lanes, approximately 60 meters east of the Highway 15 and Range Road 214 intersection. A location plan is included in Appendix A for reference.

The BF 73649E structure was constructed in 1999 when the highway was twinned, and consists of a 5.23 m diameter structural plate corrugated steel plate pipe (SPCSP), 45.7 m long, with plate thickness of 4 mm. The pipe contains a concrete end treatment on both the upstream and downstream ends with standard class 1 riprap aprons. The design height of cover based on the as-constructed drawing 17148-C is 1.37 m to the finished shoulder elevation. The as-constructed drawings for this structure are located in Appendix B for reference.

2.2 BRIDGE CULVERT HISTORY

A review of Alberta Transportation Bridge File records has provided the following information:

- A single 8.5 m span bridge was constructed, unknown year.
- A three span precast concrete bridge supported on treated timber substructures, 6.1 m – 8.5 m – 6.1 m bridge was constructed in 1956. The design flow for this structure reported in 1956 was between 22.6 m³/s and 28.3 m³/s.
- This deteriorating bridge structure was replaced in 1991 with twin precast box culverts (file number BF 73469W), based on a design flow of 27 m³/s.
- A 5.23 m diameter SPCSP pipe was installed in 1999 as part of the Highway 15 twinning project where the existing Highway 15 became the westbound lanes, and new eastbound lanes were constructed. The design summary reports the design flow as 32 m³/s.

- No reports on any additional improvements or repairs to this structure were found within the bridge file, since its construction in 1999.

2.3 SITE INSPECTION

CIMA+ representatives have visited the BF 73649E site on November 6, 2012 to verify the most recent BIM report findings. Site photographs are included in Appendix C for reference. The condition of the culvert was found to be consistent with the December 13, 2011 BIM report, noting that the interior of the barrel was not fully accessible for inspection due to thin ice within the culvert.

Based on a review of BIM Inspection Reports, bridge ratings from previous inspections are compared with the current condition, and summarized below in Table 1.

Table 1: BF 73649E BIM Inspection Report Summary Table

BIM Inspection Results	Aug 12 2003	Nov 4 2004	Sep 19 2006	May 29 2008	Mar 16 2010	Dec 13 2011	Remarks
Approaches	7	7	7	7	7	7	
Upstream End	8	8	8	8	6	6	Several cracks in end treatment observed.
Barrel	7	7	N	N	N	N	
Downstream End	7	7	7	7	7	7	
Channel	7	7	7	4	7	7	Erosion 20 m SE of upstream end in 2008.
Structural Condition	77.0%	77.0%	55.6%	55.6%	55.6%	55.6%	
Sufficiency Rating	78.2%	78.2%	66.1%	63.9%	63.9%	63.9%	

The BIM Inspection Manual defines a rating of '4' as the rated element being below acceptable condition but is a low priority for repairs. A rating of '3' or less is recommended for repair or replacement. Generally, a sufficiency rating near 35% or less is considered in a condition requiring attention.

The following is a summary of the factors used for evaluation of possible management strategies for the structure:

- Structural Condition
- Hydrotechnical Issues
- Geotechnical Issues
- Environmental Issues
- Roadway Geometrics
- Traffic Usage and Future Development



2.4 STRUCTURAL CONDITION

Based on a review of the most recent inspections and CIMA+ field visit, the pipe was observed to be in generally good condition.

There were no deficiencies observed in the culvert barrel. The most recent BIM indicated the coating was rated '7' with no concerns noted for corrosion of the pipe. Based on the design summary report from Assenheimer Engineering Ltd. dated February 21, 1998, the corrosion design to first perforation was in excess of 60 years. The general shape of the culvert barrel is also in good condition, with no deflection observed. While the Roof, Sidewall, and Floor elements have not been rated on the most recent BIM due to limited access, these elements were last rated a '7'. The longitudinal bolt seams are reported to have the proper lap and no cracked or separated seams have been observed.

The upstream and downstream culvert ends have been rated '6' and '7' respectively. Transverse hairline cracking was observed on both collars, while the most recent BIM also reported that wide cracks were observed on the upstream collar. The collar is considered to be functioning as intended; as such no repairs to these cracks at this time are warranted.

The life expectancy of this type of structure ranges between 50 to 60 years. Based on the construction year of 1999, the remaining life of the structure is estimated as 37 to 47 years.

Given the generally good condition of the structure, **the structural condition is not considered a controlling factor** in the assessment of this bridge file.

2.5 HYDROTECHNICAL ISSUES

The Alberta Transportation Hydrotechnical Information System (HIS) was referenced as it pertains to this site. Hydrotechnical summaries and hydrotechnical file histories are not available for BF 73649E or any upstream crossings. No flood histories at this site are available.

The estimated drainage area from HIS is 155 km². The stream profile within HIS for Astotin Creek shows an average slope of 0.0021 m/m, with the upstream reaching being steeper and the downstream reach being flatter.

Alberta Transportation's bridge file records were also searched and a review of the bridgefile has revealed the following:

Unknown	A single 8.5 m span bridge was constructed
1956	A three span 6.1 m – 8.5 m – 6.1 m bridge was constructed The design flow reported was between 22.6 m ³ /s and 28.3 m ³ /s.
1991	This bridge was replaced with twin precast box culverts (BF 73469W) The design flow of 27 m ³ /s was used.
1999	A 5.23 m diameter SPCSP pipe was installed when Hwy 15 was twinned

The design summary reports the design flow as 32 m³/s.
2008 BIM first reports that erosion is observed southeast of the upstream end. Based on a review of file information, there is no indication of hydrotechnical issues at this site. As such, **hydrotechnical issues are not considered a controlling factor** for this assessment report. When the structure requires replacement, a further hydrotechnical study would be recommended.

2.6 GEOTECHNICAL ISSUES

A geotechnical report was completed as part of the functional planning study; however this contained little detail specifically pertaining to the BF 73649E site. Borehole logs were included on the as-constructed BF 73649E drawings; however no investigation report was available from the bridge file information. A geotechnical investigation was also completed as part of the BF 73649W design in 1991. This report indicated a sand aquifer underlying the proposed culvert inverts; the boreholes at BF 73649E are consistent with this. Concerns were presented in 1991 within this report with regards to constructability of the culvert in 1991, and further file notes indicated related difficulties during construction. Potential for long term settlement of the structure, associated with pumping of the aquifer was also a concern. It was reported that any changes in ground water can increase this possibility of differential settlement.

Based on this information, the culvert should be monitored for any indication of settlement through the standard BIM process and at the standard inspection frequency. The review of the inspection reports indicate there are no apparent issues that have developed in association with the differential settlement. As such, **geotechnical issues are not considered a controlling factor** for this assessment. However, when the structure requires replacement at the end of its service life, a further geotechnical study would be recommended.

2.7 ENVIRONMENTAL ISSUES

An environmental assessment was completed as part of the functional planning study. This study indicated that Astotin Creek is fish-bearing and as such considered environmentally significant. The file review did not indicate any environmental concerns with the existing structure. The most recent BIM completed in 2011 indicates the fish passage adequacy had been rated a '7'.

A culvert replacement or major repair involving in-stream work would require further communications with Department of Fisheries and Oceans, Alberta Environment under the Code of Practice for Watercourse Crossings. Further, because the file review indicated that Astotin Creek is considered navigable at this location; application for any structure repair or replacement would be required to Transport Canada under the Navigable Waters Protection Act.

Environmental issues are not considered a controlling factor, but would need to be further considered as part of a repair or replacement strategy involving in-stream work.

2.8 ROADWAY GEOMETRICS

The current roadway standard is reported as RAD-412.4-120 as reported on the most recent BIM. The Highway 15 alignment over BF73649E is straight and relatively flat. No geometrical improvements are warranted at this location. Based on this, **geometrics are not a controlling factor** for this assessment.

2.9 TRAFFIC USAGE AND FUTURE DEVELOPMENT

The conclusions of the CIMA+ Functional Planning Study indicate that no roadway improvements are required at this location within the 50 year design horizon. As such, **Traffic Usage and future development is not a controlling factor**.

After this time frame however, intersection improvements at Range Road 214 and Highway 15 located approximately 60 m west of BF 73649E, in conjunction with the aging structure nearing the end of its service life, will likely require that this structure be replaced.

2.10 ASSESSMENT OPTIONS

The Structural Condition, Hydrotechnical Issues, Geotechnical Issues, Environmental Issues, Roadway Geometrics, and Traffic Usage and Future Development of BF 73649E have been reviewed based on the information available. No controlling factors have been identified from this review.

Due to the generally good condition of the structure and because there is no warrant for structure rehabilitation or replacement, the only option considered practical is the “Do Nothing” option.

2.10.1 Do Nothing

This option involves maintaining the status quo in terms of inspection and upkeep. No items warrant repair at this time. It is anticipated that the structure service life will be between 37-47 years based on typical values for these types of structures. Should structural condition issues, such as corrosion or barrel deflection present concerns within the desired 50 year design horizon, it is believed that various options for rehabilitation to extend the culvert service life can be considered in the future, depending on the nature of the deficiency.

2.11 RECOMMENDATION

No repairs to this structure are warranted at this time. It is recommended to continue with regular programmed BIM inspections. And should the condition of the structure significantly change, the culvert should be reassessed at that time to determine an appropriate strategy.



3.0 BF 73649W

3.1 BRIDGE CULVERT DESCRIPTION

This bridge file is located along Highway 15, crossing Astotin Creek. BF 73649W is located under the Highway 15 west bound lanes, approximately 60 meters east of the Highway 15 and Range Road 214 intersection. A location plan is included in Appendix A for reference.

The BF 73649W structure was constructed in 1991 and consists of a 4.8 m span by 3.0 m rise precast concrete box (PCB) structure, 40 m in length. The structure also contains concrete headwall and wingwalls on both the upstream and downstream ends with standard class 1 riprap aprons. The design height of cover based on the design drawing 14149-P was 2.46 m, to the finished shoulder elevation. The design drawings for this structure are located in Appendix B for reference.

3.2 BRIDGE CULVERT HISTORY

A review of Alberta Transportation Bridge File records has provided the following information:

- A single 8.5 m span bridge was constructed, unknown year.
- A three span precast concrete bridge supported on treated timber substructures, 6.1 m – 8.5 m – 6.1 m bridge was constructed in 1956. The design flow for this structure reported in 1956 was between 22.6 m³/s and 28.3 m³/s.
- This deteriorating bridge structure was replaced in 1991 with twin precast box culverts, based on a design flow of 27 m³/s.
- A 5.23 m diameter SPCSP pipe was installed upstream of BF 73649W in 1999 as part of the Highway 15 twinning project (BF 73649E), where the existing Highway 15 became the westbound lanes, and new eastbound lanes were constructed. The design summary reports the design flow as 32 m³/s.
- No reports on any additional work or repairs to this structure were found since construction in 1991.

3.3 SITE INSPECTION

CIMA+ has visited the BF 73649W site on November 6, 2012 to verify the most recent BIM report findings. Site photographs are included in Appendix C for reference.

Based on a review of BIM Inspection Reports, bridge ratings from previous inspections are compared with the current condition, and summarized in the following in Table 2.

Table 2: BF 73649W BIM Inspection Report Summary Table

BIM Inspection Results	Aug 12 2003	Nov 4 2004	Sep 19 2006	May 29 2008	Mar 16 2010	Dec 13 2011	Remarks
Approaches	7	7	7	7	7	7	
Upstream End	7	7	6	6	6	6	Wide and hairline cracks noted in 2011
Barrel	7	7	N	N	N	8	
Downstream End	7	7	7	7	7	7	Medium cracks in wingwalls noted.
Channel	7	7	7	7	7	7	
Structural Condition	77%	77%	55.6%	55.6%	55.6%	88.9%	
Sufficiency Rating	74.5%	74.5%	61.4%	63.2%	63.2%	79.8%	

The BIM Inspection Manual defines a rating of '4' as the rated element being below acceptable condition but is a low priority for repairs. A rating of '3' or less is recommended for repair or replacement.

A sufficiency rating near 35% or less is deemed in condition requiring immediate attention.

The following is a summary of the factors used in the decision for evaluation possible management strategies for the structure:

- Structural Condition
- Hydrotechnical Issues
- Geotechnical Issues
- Environmental Issues
- Roadway Geometrics
- Traffic Usage and Future Development

3.4 STRUCTURAL CONDITION

Based on a review of the most recent inspections and CIMA+ field visit, the precast boxes were observed to be in generally good condition.

There were no deficiencies observed within the boxes observed. However, some hairline to wide cracks were observed on the concrete headwalls and wingwalls at the upstream and downstream ends. On the most recent BIM, the upstream and downstream culvert ends have been rated '6' and '7' respectively. The headwall and wingwalls are considered to be functioning as intended; as such, no repairs to these cracks are warranted at this time.



The life expectancy of this type of structure is approximately 60-75 years. Based on the construction year of 1991, the remaining life of the structure is estimated as 39 to 54 years.

Given the generally good condition of the structure, **the structural condition is not considered a controlling factor** in the assessment of this bridge file.

3.5 HYDROTECHNICAL ISSUES

The Alberta Transportation Hydrotechnical Information System (HIS) was referenced as it pertains to this site. Hydrotechnical summaries and hydrotechnical file histories are not available for BF 73649W or any upstream crossings. No flood histories are available at this site.

The estimated drainage area from HIS is 155 km². The stream profile within HIS for Astotin Creek shows an average slope of 0.0021 m/m, with the upstream reach being steeper and the downstream reach being flatter.

Alberta Transportation's bridge file records were also searched and a review of the bridgefile has revealed the following:

Unknown	A single 8.5 m span bridge was constructed
1956	A three span 6.1 m – 8.5 m – 6.1 m bridge was constructed The design flow reported was between 22.6 m ³ /s and 28.3 m ³ /s.
1991	This bridge was replaced with twin precast box culverts (BF 73469W) The design flow of 27 m ³ /s was used.
1999	Adjacent to BF 73649E culvert, a 5.23 m diameter SPCSP pipe was installed when Hwy 15 was twinned. The design summary reports the design flow as 32 m ³ /s.

Based on a review of file information, there is no indication of hydrotechnical issues at this site. As such, **hydrotechnical issues are not considered a controlling factor** for this assessment report. When the structure requires replacement, a further hydrotechnical study would be recommended.

3.6 GEOTECHNICAL ISSUES

A geotechnical report was completed as part of the functional planning study; however this contained little detail specifically pertaining to the BF 73649W site. Borehole logs were also included on the as-constructed BF 73649E drawings; however no investigation report was available from the bridge file information. A geotechnical investigation was completed as part of the BF 73649W design in 1991. This report indicated a sand aquifer underlying the proposed culvert inverts. Concerns were presented in 1991 within this report with regards to constructability of the culvert, and further file notes indicated that difficulties during construction were experienced as a result. Potential for long term settlement of the structure, associated with pumping of the aquifer was also presented as a concern. It was reported that any changes in ground water can increase this possibility of differential settlement.

Based on this information, the culvert should be monitored for any indication of settlement through the standard BIM process and at the standard inspection frequency. The review of the inspection reports indicate there are no apparent issues that have developed in association with the differential settlement. As such, **geotechnical issues are not a controlling factor** for this assessment. When the structure requires replacement, a further geotechnical study would be recommended.

3.7 ENVIRONMENTAL ISSUES

An environmental assessment was completed as part of the functional planning study. This study indicated that Astotin Creek is fish-bearing and as such considered environmentally significant. The file review did not indicate any environmental concerns with the existing structure. The most recent BIM completed in 2011 indicates the fish passage adequacy had been rated a '7'.

A culvert replacement or major repair involving in-stream work would require further communications with Department of Fisheries and Oceans, Alberta Environment under the Code of Practice for Watercourse Crossings. Further, because the file review indicated that Astotin Creek is considered navigable at this location; application for any structure repair or replacement would be required to Transport Canada under the Navigable Waters Protection Act.

Environmental issues are not considered a controlling factor, but would need to be considered as part of a repair or replacement strategy involving in-stream work.

3.8 ROADWAY GEOMETRICS

The current roadway standard is reported as RAD-412.4-120 as reported on the most recent BIM. The Highway 15 alignment over BF73649W is straight and relatively flat. No geometrical improvements are warranted at this location. Based on this, **geometrics are not considered a controlling factor** for this assessment.

3.9 TRAFFIC USAGE AND FUTURE DEVELOPMENT

The conclusions of the CIMA+ Functional Planning Study indicate that no roadway improvements are required at this location within the 50 year design horizon. As such, **Traffic Usage and future development is not a controlling factor**.

After this time frame however, intersection improvements at Range Road 214 and Highway 15 located approximately 60 m west of BF 73649W, in conjunction with the aging structure nearing the end of its service life, will likely require that this structure be replaced.

3.10 ASSESSMENT OPTIONS

The Structural Condition, Hydrotechnical Issues, Geotechnical Issues, Environmental Issues, Roadway Geometrics, and Traffic Usage and Future Development of BF 73649W have been reviewed based on the information available. No controlling factors have been identified from this review.

