Director	Municipal Manager

COUNCIL AGENDA	
Date: May 27, 2024	Item: 5.

5.

DISTRICT OF WEST VANCOUVER
750 17TH STREET, WEST VANCOUVER BC V7V 3T3

COUNCIL REPORT

Date:	May 1, 2024
From:	Sean OSullivan, Senior Manager, Roads & Transportation Dave Choo, Transportation Technologist
Subject:	Bridge Asset Management Update
File:	1700.09

RECOMMENDATION

THAT

1. the report dated May 1, 2024, titled “Bridge Asset Management Update” be received for information;

2. the bridge asset management strategy be endorsed by Council; and

3. transportation related major structure and bridge asset funding requirements continue to be funded through the annual capital budgeting process.

1.0 Purpose

The purpose of this report is to provide Council with an update on the approach being taken towards the condition assessment, maintenance and reinvestment planning of the transportation related major structure and bridge assets, within the District’s road network.

2.0 Executive Summary

As a road authority and an asset owner, the District is responsible for 15 Bridges and 3 Pier structures, all of which were constructed between 1937 and 2014.

The approximate total replacement value of the structures is $73,000,000 in 2023 dollars. Annual inspection and maintenance programs are key factors in maintaining and extending the remaining useful service life of this critical infrastructure. Staff have developed and will plan applicable routine maintenance and rehabilitation programs to address known safety issues and to satisfy the latest engineering standards. If necessary, staff will initiate feasibility engineering analysis for the future replacement program of a structure, as required.

3.0 Legislation/Bylaw/Policy

The District applies specifications, standards and guidelines followed by the Ministry of Transportation and Infrastructure, ("the Ministry"), in relation to Provincial highway system bridges for the development, evaluation and maintenance of bridges and major structures within the District's own road network.

Core Guidance Documents

Canadian Highway Bridge Design Code - S6:19
The Canadian Highway Bridge Design Code CSA-S6:19 applies to the design, evaluation, and rehabilitation design of bridges and other Ministry structure types as modified and supplemented by the Bridge Standards and Procedures Manual.

Bridge Standards and Procedures Manual
This manual describes policies, specifications, standards, and guidelines to be followed in the development of bridges and related structures on the highway system in B.C. for the Ministry.

4.0 Council Strategic Objective(s)/Official Community Plan

Council Strategic Plan

Council's Strategic Plan (2024-2025) includes the following relevant Strategic Goals and Objectives:

- 4.0 Enhance the mobility within the community.
- 5.0 Deliver Municipal services efficiently.

Official Community Plan

The Official Community Plan ("OCP"), Section 2.4, outlines a need to use existing road networks more efficiently and provide a range of safe and accessible transportation options within our community and across the region. The OCP seeks to enhance road network safety for all users.

5.0 Financial Implications

Required infrastructure funding needs for major structures and bridges assets can be categorized as follows:

Annual Inspection

The anticipated required budget is $17,500 for 2024 to complete the monitoring inspection in accordance with the Ministry of Transportation's Bridge Inspection Manual.

Annual Maintenance Program

The program aims to address maintenance tasks such as minor rail, steel, and concrete member repair works.

The anticipated required annual budget is $305,000 for 2024, with $150,000 being approved as part of the Phase 1 Capital Budget and $155,000 requested as part of the Phase 2 Capital Budget Program; a similar funding need is projected for 2025. This funding will enable staff to address all the backlogged maintenance tasks that accumulated during the covid era, where these funding needs were deferred due to budget constraints and competing priorities. Once these deferred maintenance tasks are complete, an annual budget of $200,000 beyond 2025 is anticipated to meet routine maintenance funding needs.

Major Rehabilitation and Replacement Program

Based on the results and recommendations from the annual inspection report, staff will develop the applicable major rehabilitation or replacement programming on a structure-by-structure basis.

Staff are currently developing a major rehabilitation program for the Nelson Canyon Bridge and Keith Road Bridge.

Nelson Canyon Bridge

The program aims to extend its useful life by addressing seismic capacity deficiencies while also serving to protect the existing watermain transmission line traversing the structure and reducing the dead load by replacing the existing concrete deck members with a lighter pedestrian-friendly timber deck system. As the concept is to modify the existing structure rather than building a new one, it will minimize the environmental impacts caused by the construction work and the need for conducting other engineering studies such as geotechnical, hydraulic, environment, and archeology assessment. The anticipated engineering and construction cost is approximately $2,000,000 whereas the projected replacement value of the bridge is approximately $12,000,000. As point of comparison, the Highway Underpass, owned by the Ministry, located on Marine Drive between Horseshoe Bay Drive and Gleneagles Elementary School, is scheduled to undergo a major rehabilitation work in 2024. The approximate construction cost is $3,500,000, plus engineering fees.

Keith Road Bridge

Staff are currently assessing the inspection report to determine the additional engineering analyses required to finalize the project scope.

There is currently approved capital funding in place to support the planning and design work associated with both of these major structures moving ahead.

6.0 Background

The District owns 15 Bridges and 3 Pier structures which were constructed between 1937 and 2014. The approximate total replacement value of the structures is $73,000,000 in 2023 dollars. The below Table 1 outlines further information on these structure assets; an asset location map is included as **Appendix A.**

It should be noted that consideration of pedestrian bridge structures located throughout the Districts trail networks are considered as a separate grouping of assets and were not included as part of the transportation related major structural assessment.

Table 1 – District Bridge/Pier Asset List
(highlighted structures 60+ years old)

Asset Information Table					
Type	**Asset No.**	**Location**	**Length**	**Age**	**Replacement Value**
Bridge	101	420 Keith Road	53 m	72	$6,018,000
Bridge	102	498 Inglewood Avenue	18 m	38	$3,366,000
Bridge	103	3975 Marine Drive	43 m	85	$6,375,000
Bridge	104	Almondel Road	42 m	16	$7,616,000
Bridge	105	4300 Marine Drive	17 m	84	$2,788,000
Bridge	106	Nelson Canyon	68 m	68	$11,152,000
Bridge	107	Eagle Lake Road	28 m	40	$2,295,000
Bridge	108	Keith Place	40 m	33	$5,440,000
Bridge	109	1162 Millstream Road	8 m	60	$1,088,000
Bridge	110	1280 Sinclair Street	18 m	60	$2,261,000
Bridge	111	1620 Chippendale Road	78 m	16	$14,824,000
Bridge	112	2458 Chippendale Road	28 m	14	$5,338,000
Bridge Culvert	113	2306 Chippendale Road	40 m	14	$800,000
Bridge	115	2700 Chippendale Road	34 m	14	$1,394,000
Bridge	116	Burfield Place	29 m	10	$1,836,000
Pier	401	Eagle Island – Main	51 m	9	$400,000
Pier	402	Eagle Island – Island	34 m	9	$300,000
Pier	403	Eagle Island - Service	7 m	9	$50,000
				Total	**$73,341,000**

Bridges are considered as high-value capital structural assets that demand ongoing reinvestment towards maintenance and operational costs. Associated assessment, design and construction works typically involve a combination of specialized, multidisciplinary fields such as Structural, Geotechnical, Seismic, Civil, Environment, and Hydraulics.

6.1 **Previous Decisions –** Not Applicable.

6.2 **History**

Historically, the transportation bridge-related program funding needs have been addressed through annual capital budget requests. The budget funds the inspection, maintenance, and rehabilitation programs to ensure public safety.

Inspection

The primary purpose of inspection is to assess a structure's defects, such as cracks, rot, corrosion, and damages caused by debris in the watercourse or vehicle impacts. The data collected during the inspection program is typically used to determine the scope of maintenance, rehabilitation, or replacement work.

According to the Ministry's Bridge Inspection Manual, Principal and Annual Monitoring Inspection is required to visually inspect each structure. The Principal Inspection is required once every 5 years, involving a thorough inspection of the entire structure using any necessary means of access. The structures components must be close enough to physically touch each area being inspected. The Annual Monitoring Inspection is required annually to inspect components that are readily accessible with a six-foot ladder.

Historically, the District retained a consultant to inspect the bridges and piers. In 2022, the staff reviewed the recorded information within previous inspection reporting and noted that the inspection methodology, as well as the reporting format, didn't align with the Ministry's Bridge Inspection Manual format. In turn, staff developed a revised the Bridge Inspection Program which meets the Ministry's requirements, retaining a qualified professional to inspect the bridges in accordance with the developed inspection program.

Summary of the District's budget history on inspections since 2018:

Year	Budget	Scope
2018	$28,470	Principal Inspection
2019	N/A	N/A
2020	N/A	N/A
2021	N/A	N/A
2022	$67,650	Principal Inspection
2023	$10,920	Annual Monitoring Inspection

Maintenance and Rehabilitation

The primary purpose of the maintenance and rehabilitation are to ensure that the structures are functioning as intended. The scope varies from a simple paint recoat to repair works associated with the existing concrete, steel, or timber members.

Historically, the District utilized an internal maintenance team or secured external contractors to perform the maintenance and rehabilitation tasks.

Summary of the District's budget history on maintenance and rehabilitation since 2018:

Year	Budget	Scope
2018	$107,756.54	Eagle Island Dock Rehabilitation, Bridge Rehabilitation, General Maintenance
2019	$11,603	General Maintenance
2020	$16,603	General Maintenance
2021	$6,658	General Maintenance
2022	$1,536	General Maintenance
2023	$195,451	Nelson Canyon Bridge Rehabilitation Analysis, Keith Place Bridge Rehabilitation Analysis, Maintenance Contract Package Preparation, General Maintenance

7.0 Analysis

7.1 Discussion

The structure design life in the latest version of the Canadian Highway Bridge Design Code has been established at 75 years for all bridge types. A total of 6 bridges within the District's asset inventory are aged between 60 years and 85 years.

Staff have reviewed various case studies from other jurisdictions on lessons learned and best practices in asset management and developed the Asset Management Strategy to ensure public safety and maximize the value of the capital investment.

Asset Management Strategy

The goal of the strategy is to identify a structure's current conditions, explore options to extend its useful life, and if required, develop the replacement program that meets all the public demands and the latest engineering standards. Figure 1 illustrates the developed strategy.

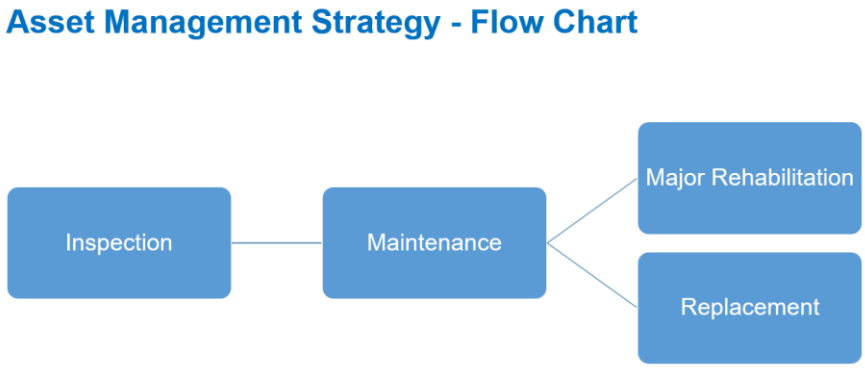

Figure 1 – Asset Management Strategy – Flow Chart

Inspection

To assess the condition of all these structural assets within the District, a consultant was hired in 2022 to:

- perform Principal Inspection and Annual Monitoring Inspections that satisfy and comply with all of the Ministry's guidelines;
- develop a suitable annual routine maintenance program to meet individual structures needs; and
- develop a remediation, rehabilitation, and maintenance program intended to inform mid and long range planning needs for the structures.

A copy of the 2022 Principal Bridge and Pier Inspection Report is included as **Appendix B.**

Maintenance

One of the key factors in maintaining and extending a structure's useful life is an annual maintenance program. In 2023, staff coordinated with the internal team and resources to prioritize and address backlogged maintenance tasks, such as debris removal and unclogging the drainage system of these major structures. Staff, in coordination with the consultant, are currently assessing the capabilities of internal resources and equipment to develop a regular annual maintenance program. For tasks that require specialized equipment and resources, staff will secure an external contractor as required. This approach aims to become a knowledgeable owner and control financial impacts by maximizing the available resources.

Major Rehabilitation / Replacement

For the major risks identified during the Principal and the Annual Monitoring Inspection Programs that are associated with a structure's useful life and public safety, staff will initiate engineering assessments such as rehabilitation feasibility and load rating assessment to evaluate the risks and develop an appropriate rehabilitation or replacement program. The following considerations will be made during the program development stage:

- usage
- expected remaining service life
- environment Impacts
- hydraulic Impacts
- geotechnical and Seismic Impacts
- utility impacts
- alternate route options and accessibility
- mobilization
- cost comparison

Capital Investment

Staff have developed a preliminary 5-year budget plan to address the inspection, maintenance, and rehabilitation program funding needs, as discussed in the Financial section of this report. Staff are currently working on the development of a 10-year budget plan to forecast the capital investment needed to maintain current load capacity, service level, and ensure public safety of these assets.

7.2 Climate Change & Sustainability

The Council's Strategic Plan supports the environment and climate change by protecting our natural environment, reduce greenhouse gas emissions, and adapt our community to become more resilient in a changing climate.

The bridge asset management strategy aims to maintain the desired service level of these critical structures and extend their useful service life, thus saving greenhouse gas emissions and protecting the environment by minimizing demolition and refraining from creating space for a replacement structure.

7.3 Public Engagement and Outreach

Not applicable.

7.4 Other Communication, Consultation, and Research

Not Applicable.

8.0 Options

8.1 Recommended Option

THAT

1. the report dated May 1, 2024, titled "Bridge Asset Management Update" be received for information;
2. the bridge asset management strategy be endorsed by Council; and
3. transportation related major structure and bridge asset funding requirements continue to be funded through the annual capital budgeting process.

8.2 Considered Options

Council may request further information or provide alternate direction (to be specified).

9.0 Conclusion

The bridge asset management strategy calls for consistent investment to maintain bridge and pier structures at their current service levels. This approach involves collecting essential data to adequately forecast the capital budget. If endorsed, it will provide for clear and consistent guidelines on managing major structure and bridge assets effectively.

Author: 

Sean O'Sullivan, Senior Manager, Roads &Transportation

Co-Author 

Dave Choo, Transportation Technologist

Appendices:

Appendix A: Location Map – District of West Vancouver Bridge & Pier Structures
Appendix B: 2022 Principal Bridge and Pier Inspection Program

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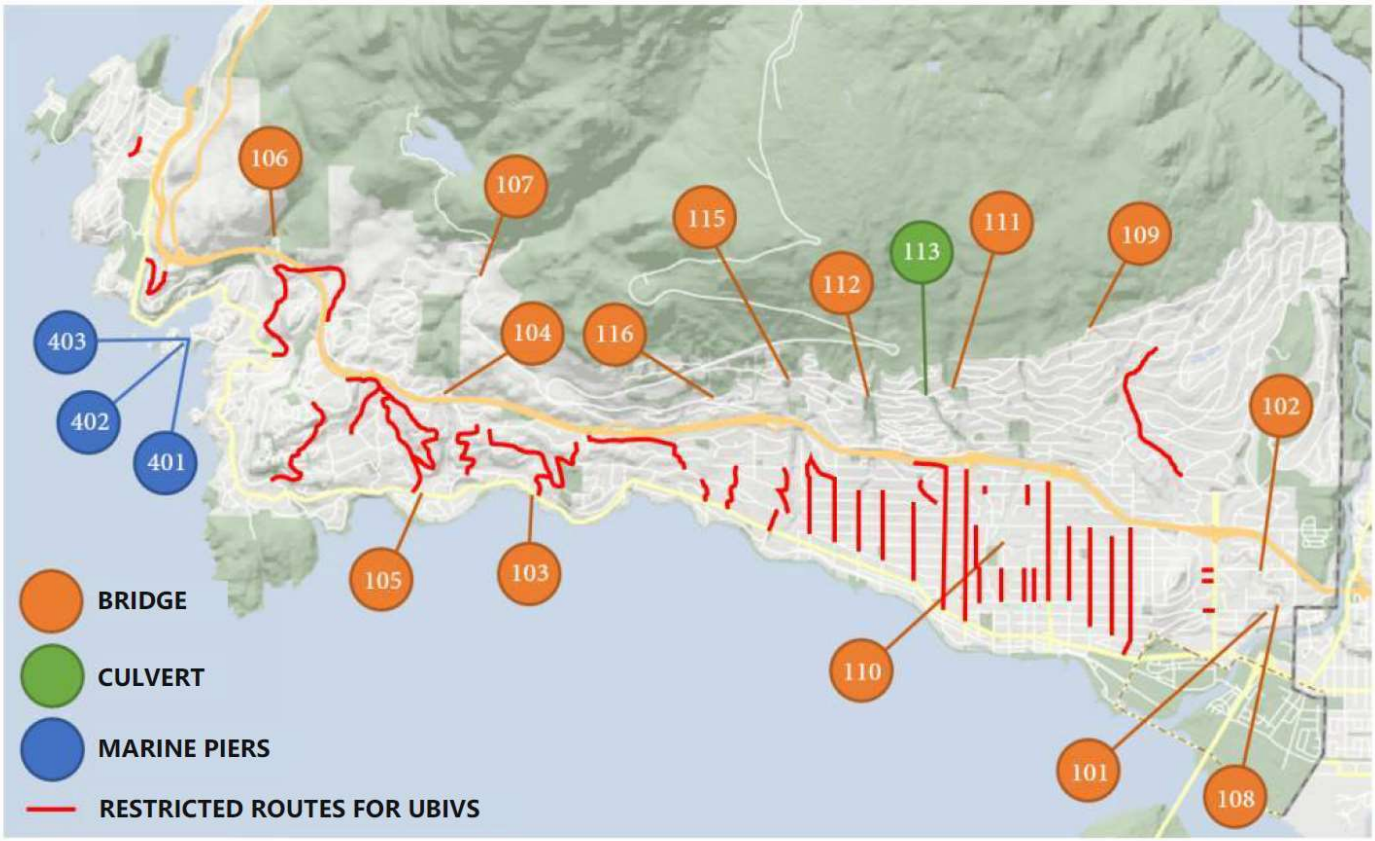
Location Map - District of West Vancouver Bridge & Pier Structures



101	Keith Road Bridge (1952)	110	Sinclair Court Bridge (1995)
102	Inglewood Road Bridge (1986)	111	Chippendale Road/McDonald Creek Bridge (2002)
103	Marine Drive/Sandy Cove Bridge (1939)	112	Chippendale Road/Marr Creek Bridge (2004)
104	Almondel Road (2008)	113	Chippendale Road/McDonald Creek Culvert (2005)
105	Marine Drive/Cypress Creek Bridge (1940, 1977)	115	Chippendale Road/Rodgers Creek Bridge (2010)
106	Nelson Canyon Bridge (1956)	116	Burfield Place Bridge (2014)
107	Eagle Lake Road Bridge (1984)	401	Mainland Pier (2015)
108	Keith Place Bridge (1991)	402	Eagle Island Pier (2015)
109	Millstream Road Bridge (1964)	403	Mainland Service Float (2015)

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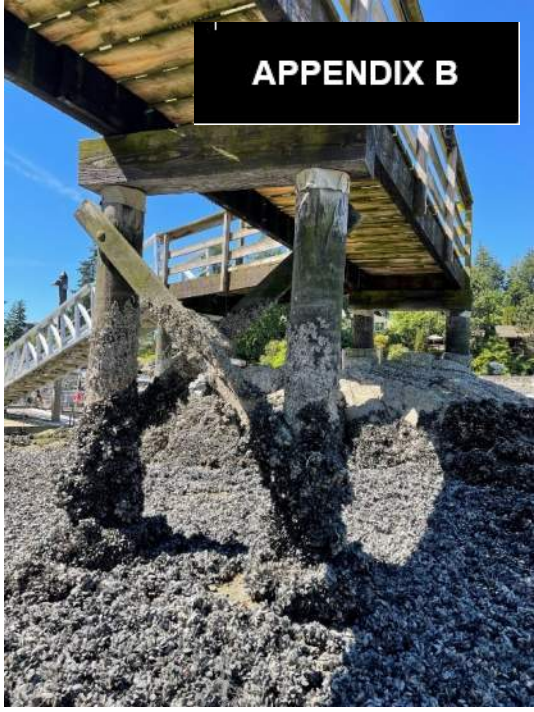


Structural Evaluation Report – November 2022

RFP22 112 – BRIDGE AND PIER INSPECTION PROGRAM

November 30, 2022 — Contract No. 52328 – Project No. 3021.0100025.000
District of West Vancouver

To:	Dave Choo, Engineering Technician District of West Vancouver	**From:**	Brook Robazza, Senior Bridge Engineer TYLin
Address:	750 17th Street, West Vancouver, BC V7V 3T3	**Date:**	November 30, 2022
Subject:	RFP22 112-Bridge and Pier Inspection Program: Structural Evaluation Report		

Transmittal Letter

Dear Mr. Choo,

TYLin International Canada Inc. (TYLin) is pleased to submit our Structural Evaluation Report summarizing our 2022 inspection findings of the 14 bridges, one culvert and three marine piers included in RFP22 112 – Bridge and Pier Inspection Program. The Structural Evaluation Report includes the following:

- Completed field inspection forms and annotated photo sheets
- Overall condition observations
- Urgency ratings
- Remaining useful life estimates
- Recommended upgrade life cycles
- Additional inspection recommendations
- Seismic upgrade priority ratings
- An annual routine maintenance program, along with estimated associated costs and specifications
- A five-year remediation and rehabilitation program with action items and estimated costs;
- Updated recommended inspection schedules

Please contact the undersigned for any questions or additional information.

Yours truly,

Brook Robazza, PhD, PEng, PE
Senior Bridge Engineer – Location Manager
TYLin International Canada Inc. (Permit to Practice No. 1000203)

Enclosed:
TYLin Reference: DWV-TYLI-REP-INSP-00001

Corporate Authorization

This document entitled "Structural Evaluation Report – October 2022" has been prepared by TYLin International Canada Inc. (TYLin) for the use of the District of West Vancouver. The information and data provided herein represent TYLin's professional judgment at the time of preparation. TYLin denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from TYLin.

Prepared by:

Jesse Gallop, M.Eng., E.I.T.
Supporting Inspection Engineer

Brook Robazza, Ph.D., P.Eng., P.E.
Primary Inspection Engineer

Terrence Davies, M.Eng., P.Eng.
Review Engineer

Revisions:

Date	Description	Revision No
2022-10-31	Initial Draft Issue	R0
2022-11-30	Final Issue, Incorporating District Comments and Requests	R1
2022-12-04	Subsequent Information Added	R2

Table of Contents

Executive Summary

TYLin International Canada Inc. (TYLin) was retained by the District of West Vancouver (the District) to complete detailed structural inspections on 14 bridges, one culvert, and three marine piers listed in the District's RFP22 112 – Bridge and Pier Inspection Program (the RFP). TYLin conducted these inspections over 4 days during September and October 2022 using a specialized underbridge inspection vehicle (UBIV), rope access technicians, personal watercraft, and the District's Hydrovac equipment to gain adequate access to all areas of each structure.

This Structural Evaluation Report was developed using all available historical reports and drawings in combination with the information accumulated during the detailed inspections. The report provides all the deliverables listed in the RFP, including the following items, which are listed in the same sequence that they are presented:

- Overall Urgency summary for all structures;
- Completed individual structure inspection forms, annotated photosheets, and an annual routine maintenance program, including recommended updated inspection schedule, cost estimates and material specifications;
- Additional inspection recommendations;
- Seismic upgrade priority rating methodology and rankings;
- Remaining useful life and recommended upgrade life cycle timeline and cost estimates;
- Five-year remediation and rehabilitation program with action items, including recommended studies and estimated associated maintenance costs;

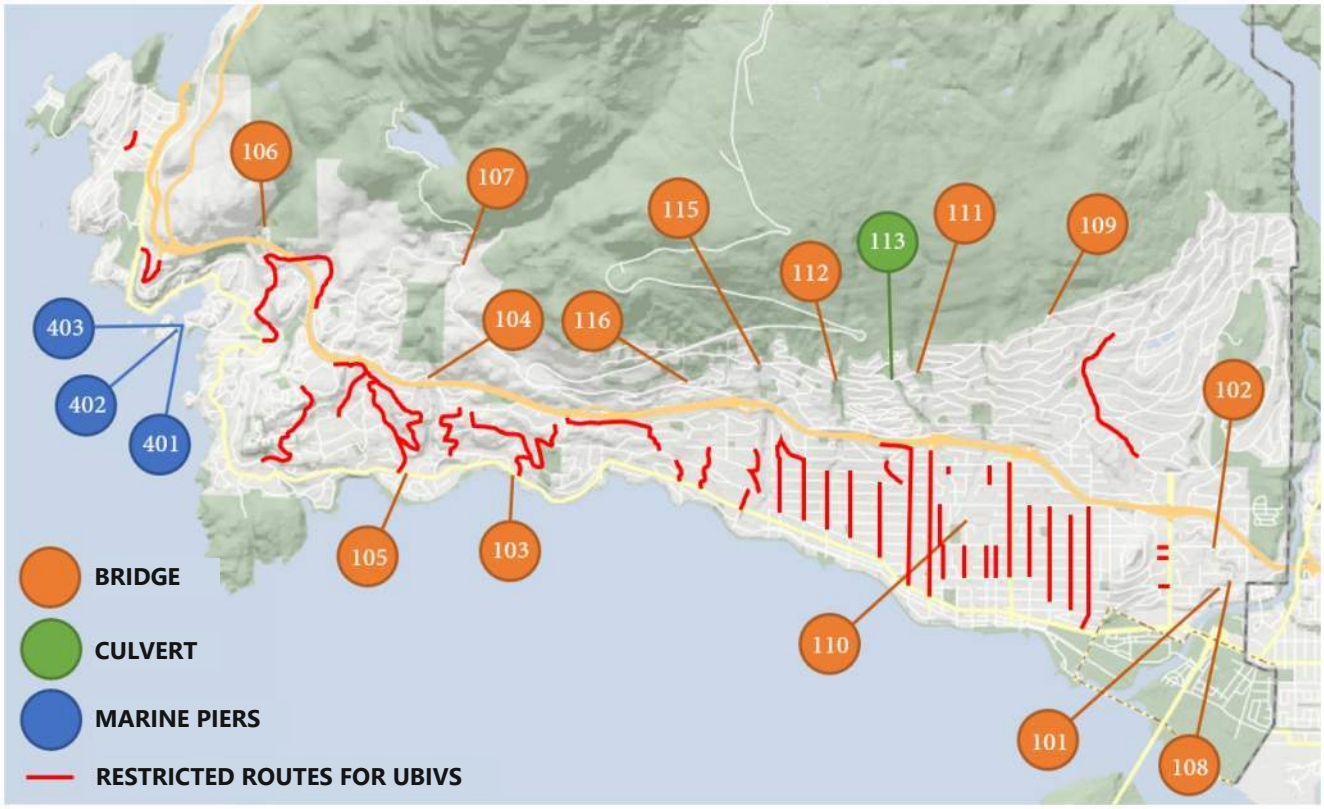
The Structural Evaluation Report includes the following:

- The structures with the highest Overall Urgency are the Keith Road Bridge (Structure ID: 101) and the Nelson Canyon Bridge (Structure ID: 106);
- The structures with the highest Priority Index for seismic upgrades are the Nelson Canyon Bridge (Structure ID: 106), the Marine Drive Bridge at Cypress Creek (Structure ID: 105), the Keith Road Bridge (Structure ID: 101), and the Eagle Lake Road Bridge (Structure ID: 107);
- The estimated approximate total cost of the recommended annual maintenance program is approximately $155,000/year, including a 20% cost contingency and a 10% allowance for engineering services;
- The estimated approximate total cost of the five-year remediation and rehabilitation program is approximately $1,200,000 total, including a 20% cost contingency and a 10% allowance for engineering services;
- Studies of retrofit options for the Keith Road Bridge (Structure ID: 101) and the Nelson Canyon Bridge (Structure ID: 106) are recommended as potential alternatives to previous recommendations for the replacement of these structures.

1 Introduction

TYLin International Canada Inc. (TYLin) was retained by the District of West Vancouver (the District) to complete detailed structural inspections and prepare condition assessment reports on 14 bridges, one culvert, and three marine piers, as shown in Figure 1, assign seismic upgrade priority ratings, develop annual routine maintenance recommendations, and a five-year remediation and rehabilitation program. The deliverables included in the inspection program are listed in the District's RFP22 112 – Bridge and Pier Inspection Program (the RFP), and the individual structures are described in detail in Appendix A. TYLin initiated this assignment with a series of reconnaissance site visits to all 18 of the structures to assist in developing the inspection schedule and planning necessary inspection access equipment required for each structure.

Figure 1. Inspection Program Structure Map (Structure IDs and Dates of Construction)



101 Keith Road Bridge (1952)
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116 Burfield Place Bridge (2014)
401 Mainland Pier (2015)
402 Eagle Island Pier (2015)
403 Mainland Service Float (2015)

1.1 Inspection Scope

The 2022 Inspections consisted of both "Principal Inspections" and "Monitoring Inspections." Principal Inspections are defined in the RFP as highly-detailed inspections that cover the entire structure and with the primary purpose of developing maintenance, remediation and rehabilitation programs. The Principal Inspections generally involved inspecting all above-ground structural elements from within a distance of the 1 m of their exterior surface, which enabled TYLin to detect corrosion and take indicative section loss measurements and paint samples of steel members; identify checking, cracks, or decay in timber sections; assess cracking and delamination of concrete components; and make articulation performance and condition assessments of bridge bearings. In contrast, the annual Monitoring Inspections are higher level and only require the visual inspection of readily accessible structural elements with the general intent to examine existing defects, confirm repairs, and identify new defects when encountered. The less-intensive Monitoring Inspections generally use the Principal Inspections as a benchmark for identifying changing behaviour or defects. For all defects identified in the field, TYLin noted the approximate location and prevalence and took inventory photographs of the area.

This report includes the results of the 17 Principal Inspections and one Monitoring Inspection performed in 2022 per the requirements of the RFP. The single 2022 Monitoring Inspection was conducted on the Keith Road Bridge (Structure ID: 101), which had previously been planned to be replaced in 2019, allowing TYLin to comment on the structure's condition and potential replacement.

TYLin recorded performance deficiencies and material defects using enhanced BC MoTI Bridge Condition Inspection Forms, which included additional note fields for the general inspection findings, utility concerns, urgency rating, and seismic vulnerability. The rating systems used in these inspection forms are included in Table 1, Table 2, and Table 3. Field-recorded information was accompanied by a list of anticipated required maintenance and rehabilitation work, an Overall Urgency rating, and a seismic hazard vulnerability assessment, which was used to identify structures that may require seismic upgrades.

1.2 Inspection Details

Separate inspection planning was conducted for both the Principal Inspections, which needed to be completed before November 30, 2022, and the Monitoring Inspections, which are generally to be completed annually over the following four years (except for Keith Road Bridge, Structure ID: 101). TYLin provided all required labour, tools, traffic control, specialized equipment, and materials to complete the 2022 Inspections. In addition, TYLin developed the site-specific safety plans and fulfilled the role of Prime Contractor as defined by WorkSafeBC requirements.

Figure 2. UBIV Inspection Access

Nine of the Principal Inspections required an Underbridge Inspection Vehicle (UBIV) to gain access to fulfill the close-proximity inspection requirements, as shown in Figure 2 (Structure ID's: 102, 103, 104,

107, 108, 109, 111, 112, 115). To support these inspections, TYLin enlisted a traffic management company to implement traffic control measures while the UBIV was on-site to facilitate its safe positioning around single-lane-alternating traffic. After reviewing all available documents for the Nelson Canyon Bridge (Structure ID: 106), TYLin determined that no detailed Canadian Highway Bridge Design Code (CHBDC) CAN/CSA S6-19 Section 14 load rating had been completed for the bridge. As a result, the load-carrying capacity of the bridge could not be confirmed, leading TYLin to retain a Rope Access Technician (RAT) team to provide inspection access rather than a UBIV. For the three pier/float structures in Eagle Harbour, TYLin used personal watercraft to access the structures at both high and low tide. The remaining structures could be adequately inspected from the ground to accomplish the close-proximity inspection requirements.

TYLin received District assistance in accessing the abutments of the Eagle Lake Road Bridge (Structure ID: 107), which had become buried under debris. The District used a hydrovac to remove a portion of this debris in coordination with TYLin. Additionally, due to the single-lane configuration of Burfield Place Bridge (Structure ID: 116), traffic-closure restrictions meant that a UBIV could not be used to complete a close-proximity inspection; however, after discussions with the District, TYLin determined that due to the relatively low importance and vulnerability of the bridge, drone imagery, provided by the District, could be used to inspect the portions of the structure that were inaccessible on foot.

Table 1. Component Condition Rating System

Rating "GC"	General Condition
E (Excellent)	As-new condition
G (Good)	Normal wear and deterioration; does not require maintenance or repair
F (Fair)	Minor defects, deterioration or collision damage: generally requires maintenance or repair
P (Poor)	Advanced deterioration; significant defects or collision damage; repair required
V (Very Poor)	Serious defects, deterioration or collision damage; imminent failure of component requiring immediate repair or replacement and/or load restrictions
X (Not Inspected)	Used when that component could not be inspected due to obstruction, access constraints, etc.
N / A	Used when that component is not present in the structure

Note: Refer to BC MoTI Bridge Management Information System User Manual (2015)

Table 2. Component Urgency Rating System

Rating "CU"	Component Urgency
R (Routine)	Routine maintenance work
1 (4yrs or >)	Work not required before the next detailed inspection
2 (< 3yrs)	Work required within the specified time period
3 (< 2yrs)	Work required within the specified time period
4 (ASAP)	Immediate repair required

Note: This item was added to the BC MoTI Bridge Condition Inspection Form (2019)

Table 3. Overall Urgency Rating System

Rating "OU"	Overall Urgency
1	**No Repairs, No Safety Concern** Strength: The structure retains its original design load-carrying capacity and requires no repairs at this time. Safety: There is no safety concern on the structure.
2	**Non-Structural Repairs, No Safety concern** Strength: The structure retains its original design load-carrying capacity but requires non-structural repairs. Safety: There is no safety concern on the structure.
3	**Minor Structural Repairs, Minor Safety Concern** Strength: The structure's design load-carrying capacity may be reduced to a minor extent; the structure requires some minor structural repairs. Safety: There may be a minor safety concern on the structure.
4	**Moderate Priority Structural Repairs, Moderate Safety Concern** Strength: The structure's design load-carrying capacity is reduced to a moderate extent, but no load posting is yet being considered; the structure requires moderate priority structural repairs to remain in long-term service. Safety: There is a moderate safety concern.
5	**High Priority Structural Repairs, Significant Safety Concern** Strength: The structure's design load-carrying capacity is reduced significantly; a load posting has been applied or is being considered; the structure requires high-priority structural repairs to remain in service. Safety: There is a significant safety concern.

Note: Refer to BC MoTI Bridge Management Information System User Manual (2015)

All of the inspections were completed by Brook Robazza, Ph.D., P.Eng., P.E. and Jesse Gallop, M.Eng., E.I.T., and the inspection results were reviewed by Terrence Davies, M.Eng., P.Eng.

2 Bridge Inspections

This section of the report provides a summary of the inspection findings from the 2022 Inspections. The inspection findings are provided in full in Appendix A, and include the Overall Urgency rating; completed individual structure inspection forms, annotated photosheets, and an annual routine maintenance program, including recommended updated inspection schedules, cost estimates; and additional inspection recommendations. A summary of the general structural inspection and Overall Urgency Ratings for each structure is provided in Table 4.

Table 4. General Structure Information

Struct ID	Photos	Approx. Location	Feature Crossed	Year Built	Approx. Length (m)	Approx. Width (m)	Approx. Plan Area (m^2)	No. of Spans	Structure Materials	Overall Urgency Rating
101		420 Keith Road	Brothers Creek	1952	52.8	8.2	432.6	3	Steel and Timber	4
102		498 Inglewood Avenue	Brothers Creek	1986	18.0	7.0	126.0	1	Precast Concrete	2
103		3975 Marine Drive	Historical Godman Creek Channel	1939	42.8	10.0	428.0	3	Steel and Concrete	3

Struct ID	Photos	Approx. Location	Obstacle Spanned	Year Built	Approx. Length (m)	Approx. Width (m)	Approx. Plan Area (m^2)	No. of Spans	Structure Materials	Overall Urgency Rating
104		North of Almondel Pl on Almondel Rd	Cypress Creek	2008	41.4	10.7	443.0	1	Precast Concrete	1
105		4375 Marine Drive	Cypress Creek	1940 1977	17.0	10.4	176.8	1	Steel and Concrete	2
106		North of Trans-Canada Hwy on Nelson Creek	Nelson Canyon	1956	68.0	10.4	707.2	4	Steel and Concrete	4
107		Eagle Lake Rd on Cypress Creek	Cypress Creek	1984	27.8	4.3	119.5	1	Steel and Timber	2

Struct ID	Photos	Approx. Location	Obstacle Spanned	Year Built	Approx. Length (m)	Approx. Width (m)	Approx. Plan Area (m^2)	No. of Spans	Structure Materials	Overall Urgency Rating
108		345 Keith Pl	Brothers Creek	1991	39.9	7.8	311.5	1	Steel and Concrete	3
109		1162 Millstream Rd	Brothers Creek	1964	8.0	7.0	56.0	1	Precast Concrete	3
110		1310 Sinclair St	Lawson Creek	1995	18.0	7.8	140.4	1	Precast Concrete	2
111		1620 Chippendale Rd	McDonald Creek	2002	77.6	11.4	884.6	3	Precast Concrete	2

Struct ID	Photos	Approx. Location	Obstacle Spanned	Year Built	Approx. Length (m)	Approx. Width (m)	Approx. Plan Area (m^2)	No. of Spans	Structure Materials	Overall Urgency Rating
112		2458 Chippendale Rd	Marr Creek	2004	28.0	10.0	280.0	1	Precast Concrete	2
113		2306 Chippendale Rd	McDonald Creek	2005	40.0	4.0	160.0	1	Precast Concrete	2
115		2817 Chippendale Rd	Rodgers Creek	2010	33.2	10.5	349.0	1	Precast Concrete	2
116		3032 Burfield Pl	Pipe Creek	2014	28.7	6.9	197.7	1	Precast Concrete	2

Struct ID	Photos	Approx. Location	Obstacle Spanned	Year Built	Approx. Length (m)	Approx. Width (m)	Approx. Plan Area (m^2)	No. of Spans	Structure Materials	Overall Urgency Rating
401		5771 Eagle Harbour	Eagle Harbour	2015 Major Rehab	51.0	1.6	81.6	9	Aluminum and Timber	3
402		5771 Eagle Harbour	Eagle Harbour	2015 Major Rehab	33.5	1.6	53.6	2	Aluminum and Timber	2
403		5771 Eagle Harbour	Eagle Harbour	2015 Major Rehab	18.3	1.6	29.3	1	Aluminum and Timber	2

2.1 2022 Inspection Findings

The inspection findings included varying degrees of steel corrosion, concrete spalling and delamination; coating failures; timber decay; eroding embankments; approach roadway settlement; missing signage and approach barriers; and debris buildup. Detailed descriptions and inspection findings for each structure are included in Appendix A using the enhanced BC MoTI Bridge Condition Inspection Forms.

2.2 Additional Investigation Recommendations

Based on the 2022 Inspection results, the additional investigation details provided in Table 5 are recommended as requested in the RFP.

Table 5. Additional Investigation Details

Struct ID	Approx. Location	Additional Investigation Details
101	420 Keith Road	1. Load Rating Analysis Study to confirm the gravity-load capacity of the structure, with a focus on the floorbeams. 2. Barrier Capacity Analysis to confirm the capacity of the potentially vulnerable existing timber railings for vehicle impact. 3. Seismic Evaluation Study to confirm the capacity of the seismic force-resisting system of the existing structure, with a focus on the pier legs. 4. Retrofit Options Study using the above studies to determine an appropriate potential retrofit strategy for the bridge.
106	North of Trans-Canada Highway on Nelson Creek	1. Load Rating Analysis Study to confirm the gravity-load capacity of the structure, with a focus on the deteriorated floorbeams and horizontal pier members. This is optional in case it is desired that the structure is to be reused in its existing state. 2. Seismic Evaluation Study to confirm the capacity of the seismic force-resisting system of the existing structure, with a focus on the pier members and the connections to the pier pedestals. 3. Retrofit Options Study using the above studies to determine an appropriate potential retrofit strategy for the bridge.
401	5771 Eagle Harbour	1. Timber drilling test using Haglof incremental boring probe, IML-RESI MD300 drill, or similar to confirm the existing pile integrity and capacity. This information would be helpful in providing additional confidence for the condition of the timber supports.

Note that the studies listed in Table 5 require additional discussion between TYLin and the District as they represent investigations that could vary widely in scope. For example, the seismic evaluation of the Nelson Canyon Bridge (Structure ID: 106) could initiate as a basic Response Spectrum Analysis (RSA) and progress to a Non-Linear Time-History Analysis if the demands from the RSA were determined to be too conservative. Approximate cost estimates are included in the 5-year remediation and rehabilitation program costs for each structure based on the anticipated scope and other recent studies of similar scope.

2.3 Annual Routine Maintenance Program Summary

This section summarizes the recommended action items listed in the annual routine maintenance programs for each bridge in Appendix A. Table 6 provides this summary in tabular format and distinguishes action items that may require specialized personnel and equipment from those that do not. All costs are based on approximate current market rates, i.e. it is assumed that the District will contract out this work rather than using District staff. Cost savings may be available if the work is performed by District staff instead. The costs provided include both a 20% cost contingency and a 10% engineering services allowance on top of the Appendix A approximate cost estimates.

Table 6. Annual Routine Maintenance Program Summary.

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
101	420 Keith Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	9,750
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$2,000; no associated specification).	N	2,000	2,600	
		4. Spot Overcoating Timber Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers; however, surface preparation standards may be relaxed to account for timber rather than steel materials).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).		1,500	1,950	
		8. Reseal Asphalt Deck Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
102	498 Inglewood Avenue	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	9,750
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Vegetation from Deck Overhangs (~$1,500; no associated specification).	N	1,500	1,950	
		4. Clean Debris from Bearing Areas (~$500; no associated specification).	N	500	650	
		5. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		6. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		7. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		8. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		9. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	
103	3975 Marine Drive	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	9,750
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$2,000; no associated specification).	N	2,000	2,600	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		8. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
104	North of Almondel Place on Almondel Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Drain Holes, Sidewalk, and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	
105	4375 Marine Drive	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		6. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		7. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
106	North of Trans-Canada Hwy on Nelson Creek	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	18,200
		2. Clean Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Vegetation from Deck Overhangs (~$2,000; no associated specification).	N	2,000	2,600	
		4. Reseal Deck Joints ($2,000; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 413.32.06b)	Y	2,000	2,600	
		5. Clean Debris from Bearing Areas and Horizontal Non-Free-Draining Members (~$6,000; no associated specification).	Y	6,000	7,800	
		6. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		7. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		8. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
107	Eagle Lake Road on Cypress Creek	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	6,500
		2. Clean Deck and Drainage Channels (~$2,000; no associated specification).	N	2,000	2,600	
		3. Clean Debris from Bearing Areas (~$1,500; no associated specification).	N	1,500	1,950	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
108	345 Keith Place	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Vegetation from Deck Overhangs (~$500; no associated specification).	N	500	650	
		4. Clean Debris from Bearing Areas (~$500; no associated specification).	N	500	650	
		Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using	N	1,000	1,300	
		6. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		7. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		8. Install and Confirm Bottom Flange Barriers are in Place, As Needed.	Y			
		9. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		10. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
109	1162 Millstream Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	7,800
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Vegetation from Deck Overhangs (~$500; no associated specification).	N	500	650	
		Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using	N	1,000	1,300	
		4. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		5. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		6. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	Y	1,500	1,950	
		7. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	
110	1310 Sinclair Street	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	7,150
		2. Clean Sidewalk and Gutters (~$1,000; no associated specification).	N	1,000	1,300	
		Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using	N	1,000	1,300	
		4. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		5. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		6. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).		1,500	1,950	
		7. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	
111	1620 Chippendale Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
112	2458 Chippendale Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	
113	2306 Chippendale Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	5,850
		2. Touch-Up Coating of Galvanized Steel Railings and Culvert Pipe Walls (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		3. Remove Debris from Culvert Interior (~$1,500; no associated specification).	N	1,500	1,950	
		4. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		5. Tighten Loose Culvert Splice Bolts to Snug-Tight Condition, As Needed.	N			
		6. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
115	2817 Chippendale Road	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	
116	3032 Burfield Place	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	8,450
		2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed.	Y			
		6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).	N	1,500	1,950	
		8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	Y	1,500	1,950	

Struct ID	Approx. Location	Estimated Annual Routine Maintenance Item	Specialized Personnel or Equipment Required (Yes/No)	Estimated Approx. Cost (CAD)	+20% Cost Cont. and +10% Eng. Services (CAD)	Total Annual Routine Maintenance Costs (CAD)
401	5771 Eagle Harbour	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	9,100
		2. Clean Pier and Float Decks (~$2,000; no associated specification).	N	2,000	2,600	
		3. Clean Debris from Bearing Areas (~$2,000; no associated specification).	N	2,000	2,600	
		4. Touch-Up Coating of Galvanized Components (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Float Edges due to Boat Strikes, As Needed.	Y			
		6. Tighten Loose Connection Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Pier and Float (~$1,500; no associated specification).	Y	1,500	1,950	
402	5771 Eagle Harbour	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	6,500
		2. Clean Pier and Float Decks (~$1,500; no associated specification).	N	1,500	1,950	
		3. Clean Debris from Bearing Areas (~$1,000; no associated specification).	N	1,000	1,300	
		4. Touch-Up Coating of Galvanized Components (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	1,000	1,300	
		5. Repair or Float Edges due to Boat Strikes, As Needed.	Y			
		6. Tighten Loose Connection Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Pier and Float (~$1,000; no associated specification).	Y	1,000	1,300	
403	5771 Eagle Harbour	1. Monitoring Inspection (~$500; no associated specification).	Y	500	650	3,900
		2. Clean Pier and Float Decks (~$1,000; no associated specification).	N	1,000	1,300	
		3. Clean Debris from Bearing Areas (~$500; no associated specification).	N	500	650	
		4. Touch-Up Coating of Galvanized Components (~$500; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers).	N	500	650	
		5. Repair or Float Edges due to Boat Strikes, As Needed.	Y			
		6. Tighten Loose Connection Bolts to Snug-Tight Condition, As Needed.	N			
		7. Remove Debris from Channel Under Pier and Float (~$500; no associated specification).	Y	500	650	

3 Seismic Upgrade Priority and Seismic Evaluation Methodology

The RFP includes a requirement to provide identification of bridge structures requiring seismic upgrades. TYLin has recently completed a series of seismic upgrade/retrofit designs for BC Ministry of Transportation and Infrastructure (BC MoTI) bridges on in West Vancouver in 2022. From this experience, TYLin is aware that current NBCC 2020 seismic hazard accelerations for both Site Class B (typical of bedrock foundation in West Vancouver) and Site Class D (typical of bridge end fill foundations) have increased significantly over the superseded NBCC 2015 seismic hazard accelerations. TYLin expects the seismic hazard accelerations to have increased by 15% to 50% for all the bridge structures in this inspection program. The increased seismic hazard imposed on the bridge structures means that even structures that have been retrofitted in the past may not be precluded from significant damage during a large seismic event. While the pier and culvert structures also face increased seismic demands, the increase is not expected to be as significant due to their anticipated period ranges being less affected by the NBCC 2020 seismic hazard changes.

Since all the bridge structures will likely require seismic upgrading in some form, determining a way of prioritizing the seismic upgrades is prudent so that appropriate budgeting and planning can be established. To address this, TYLin developed a "Priority Index" that ranks each structure in terms of its need for a seismic upgrade. This Priority Index is calculated using an "Importance Index" and a "Vulnerability Index," which are all described in this section of the report.

Once the Priority Index has been established, the next step is to determine the level of seismic upgrade (retrofit) required. The expense of seismic upgrade/retrofit can vary widely, with some retrofits requiring only the addition of shear keys and others requiring extensive member strengthening. Therefore, a method of determining the required level (category) of seismic retrofit is important for budgeting purposes. TYLin has provided a basic methodology to determine the seismic retrofit category required for each structure based on the BC MoTI Seismic Retrofit Design Criteria (SRDC, 2005) and the Seismic Retrofitting Manual for Highway Structures: Part 1 – Bridges (SRMHS, US Department of Transportation, Federal Highways Administration, 2006).

Given that all the bridges in the District's inventory are likely not to meet the seismic performance requirements of current codes and seismic hazard values, TYLin recommends that seismic assessments be completed for all these structures in the future. The Priority Index and seismic retrofit categories for each structure will be important for determining the sequence of completing these assessments. The Priority Index provides the ideal seismic assessment and retrofit sequence, omitting costs, and the seismic retrofit category provides expected costs on a relative basis.

3.1 Priority Index

3.1.1 Importance Rating

The structure importance rating includes the assessment of the structure's importance based on traffic volume, lifeline utility, and disaster response route. These classifications have been made on

the basis of social/survival usage, economic recovery requirements, and engineering judgment. The importance rating is calculated as the sum of individual rating categories for traffic volume, lifeline utilities, and disaster response route. The ratings use a scale of 0 to 3 for each rating category, with each scale using varying breakdowns and judgement. In each category, higher ratings indicate higher importance in that category. The highest possible importance rating is therefore equal to 9 (3+3+3). The importance rating of all the structures is presented in Table 8.

3.1.1.1 Traffic Volume

The traffic volume rating is representative of the importance of the structure to the local population and economy. The traffic volume is categorized into low, medium, and high based on the road classification: local, collector/distributor, or arterial, corresponding to ratings of 1 to 3, respectively.

3.1.1.2 Lifeline Utilities

The reference to bridge importance classifications is defined in Section 2.1 of the BC MoTI SRDC and is associated with the importance guidelines of CHBDC CAN/CSA S6-19 Section 4.4.2. As illustrated by Figure 3, most of the structures support a watermain utility and are therefore considered lifeline bridges. However, an increased rating is given to bridges located at higher elevations or ones that serve a larger catchment population, which are considered of higher importance. A rating of 3 indicates a structure supporting a watermain with a high elevation or large catchment area, whereas a rating of 1 indicates a watermain of lower significance. A rating of 0 is given to structures that do not support a watermain.

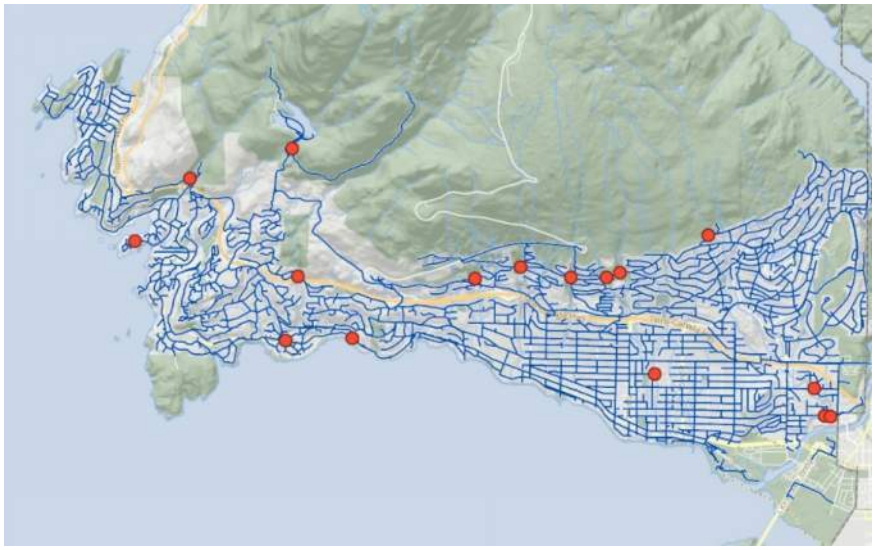


Figure 3. West Vancouver Utility Map: Watermains in Blue and Red Dots at Structure Locations

3.1.1.3 Critical Route

In the Lower Mainland and Vancouver Island, a system of routes have been designated Disaster Response Routes (DRRs). DRRs are corridors that must be kept open for emergency vehicle response following a major earthquake. In this inspection program, Marine Drive over Cypress Creek (Structure

ID: 103) and Marine Drive at Sandy Cove (Structure ID: 105) are the only bridges on the DRRs. Other important routes are those that have no other detour available, i.e. Eagle Lake Road (Structure ID: 107), Keith Place (Structure ID: 108), Eagle Island Pier (Structure ID: 402), and Sinclair Court (Structure ID: 110). These DRR structures are assigned a rating of 3, the structures on routes without a detour are assigned a rating of 2, and the other structures are assigned a rating of 0.

3.1.2 Vulnerability Rating

The seismic vulnerability rating of a structure measures its vulnerability to damage resulting from a seismic event of a given intensity, which is taken as the 1-in-975 year seismic event (5% in 50 years probability of occurrence) in accordance with the SRDC and the SRMHS. In order to quantify a structure's vulnerability, a vulnerability rating system is proposed based on the remaining useful life, seismic force-resisting system, configuration, and foundation factors. Each of these four categories uses a rating of 0 to 3, with the most vulnerable structures in each category receiving a 3 and the least vulnerable a 0. The highest possible vulnerability rating is therefore equal to 12 (3+3+3+3). The vulnerability rating of all the structures is presented in Table 8.

3.1.2.1 Remaining Useful Life

A key consideration in deciding the extent to which a bridge should be retrofitted is the Remaining Useful Life (RUL). Retrofitting a bridge with a short RUL is difficult to justify for two reasons: it is not economical, and the design earthquake is less likely to occur during the remaining life of the structure. Bridges with a short RUL are therefore given a rating of 3 to indicate a need for a near-future replacement or reassessment for seismic performance.

On the other hand, a bridge that is almost new or being rehabilitated to extend its service life should be retrofitted for a longer remaining useful life. These structures are given a rating of 1. A design service life of 75 years was generally assumed to establish these categories but was also modified based on the inspection findings. The RUL rating is divided into three separate categories, as presented in Table 7.

Table 7. Remaining Useful Life Categories

Service Life Category	RUL (Years)	Rating
RUL 1	**> 50**	1
RUL 2	16 – 50	2
RUL 3	0 – 15	3

3.1.2.2 Seismic Force-Resisting System

Seismic Force-Resisting Systems (SFRS) are distinct elements that are capable of transferring seismic forces from the distributed masses of a structure to the foundations and may include shear keys, bracing, diaphragms, and other load path components. Table 8 gives a rating of 3 to structures with robust SFRSs and 0 for structures without a clear SFRS.

Table 8. Seismic Upgrade/Retrofit Priority

Struct ID	Bridge Name	Importance (maximum 9 points)				Vulnerability (maximum 12 points)						Priority (maximum 21 points)
		Traffic Volume	Lifeline Utility	Critical Route	Importance Rating	RUL* (Years)	RUL Category	SFRS	Configuration	Foundation Conditions	Vulnerability Rating	Priority Rating (Importance + Vulnerability)
101	420 Keith Rd	2	2	0	**4**	5	3	2	2	1	**8**	**12**
102	498 Inglewood Ave	2	2	0	**4**	38	2	0	0	0	**2**	**6**
103	3975 Marine Dr	3	2	3	**8**	20	2	0	0	0	**2**	**10**
104	North of Almondel Pl on Almondel Rd	2	3	0	**5**	61	1	0	0	0	**1**	**6**
105	4375 Marine Drive	3	2	3	**8**	10	3	3	1	0	**7**	**15**
106	North of Trans-Canada Hwy on Nelson Creek	2	3	0	**5**	9	3	3	3	2	**11**	**16**
107	Eagle Lake Rd on Cypress Creek	1	3	2	**6**	37	2	3	0	3	**8**	**14**
108	345 Keith Pl	1	1	2	**4**	19	2	3	2	0	**7**	**11**
109	1162 Millstream Rd	1	1	0	**2**	17	2	1	0	0	**3**	**5**
110	1310 Sinclair St	2	1	2	**5**	48	2	0	0	2	**4**	**9**
111	1620 Chippendale Rd	2	3	0	**5**	55	1	0	1	0	**2**	**7**
112	2458 Chippendale Rd	2	3	0	**5**	57	1	0	0	0	**1**	**6**
113	2306 Chippendale Rd	2	3	0	**5**	57	1	0	0	0	**1**	**6**
115	2817 Chippendale Rd	2	3	0	**5**	63	1	0	0	0	**1**	**6**
116	3032 Burfield Pl	1	3	0	**4**	67	1	0	0	0	**1**	**5**
401	5771 Eagle Harbour	1	0	0	**1**	15	3	3	0	2	**8**	**9**
402	5771 Eagle Harbour	1	0	2	**3**	15	3	3	0	2	**8**	**11**
403	5771 Eagle Harbour	1	0	0	**1**	15	3	3	0	1	**7**	**8**

Table 9. Priority Index

Struct ID	Bridge Name	Importance Rating	Vulnerability Rating	Priority Rating	Priority Index (Low Governs)
106	North of Trans-Canada Hwy on Nelson Creek	5	11	16	**1**
105	4375 Marine Dr	8	7	15	**2**
107	Eagle Lake Rd on Cypress Creek	6	8	14	**3**
101	420 Keith Rd	4	8	12	**4**
108	345 Keith Pl	4	7	11	**5**
402	5771 Eagle Harbour	3	8	11	**5**
103	3975 Marine Drive	8	2	10	**7**
110	1310 Sinclair St	5	4	9	**8**
401	5771 Eagle Harbour	1	8	9	**8**
403	5771 Eagle Harbour	1	7	8	**10**
111	1620 Chippendale Rd	5	2	7	**11**
102	498 Inglewood Ave	4	2	6	**12**
104	North of Almondel Pl on Almondel Rd	5	1	6	**12**
112	2458 Chippendale Rd	5	1	6	**12**
113	2306 Chippendale Rd	5	1	6	**12**
115	2817 Chippendale Rd	5	1	6	**12**
109	1162 Millstream Rd	2	3	5	**17**
116	3032 Burfield Pl	4	1	5	**17**

3.1.2.3 Configuration

The geometry of the bridge significantly affects its seismic performance, with simple geometry bridges demonstrating generally better performance relative to those with complex geometries. The highest rating of 3 is given to complex bridges such as the Nelson Canyon Bridge (Structure ID: 106) to reflect that a skewed, multi-span bridge is expected to perform poorly relative to simply-supported unskewed structures, which are given a rating of 0.

3.1.2.4 Foundation Conditions

Structures with poor foundation conditions are generally subjected to higher seismic demands relative to structures with better foundation conditions. For example, a typical West Vancouver structure with a fundamental frequency of 0.3 seconds may experience 70% higher seismic demands if it is supported on Site Class B foundations rather than Site Class D foundations. While a geotechnical investigation is required for a thorough assessment of the bridge foundations, TYLin used a combination of as-built drawings and inspection observations to develop a preliminary estimate of the foundation conditions for each structure. Structures with strong bedrock conditions, such as the Millstream Road Bridge (Structure ID: 109), are assigned a rating of 3 for this category, whereas structures on unsupported loose soils, such as the Eagle Lake Road Bridge (Structure ID: 107) are assigned a rating of 0.

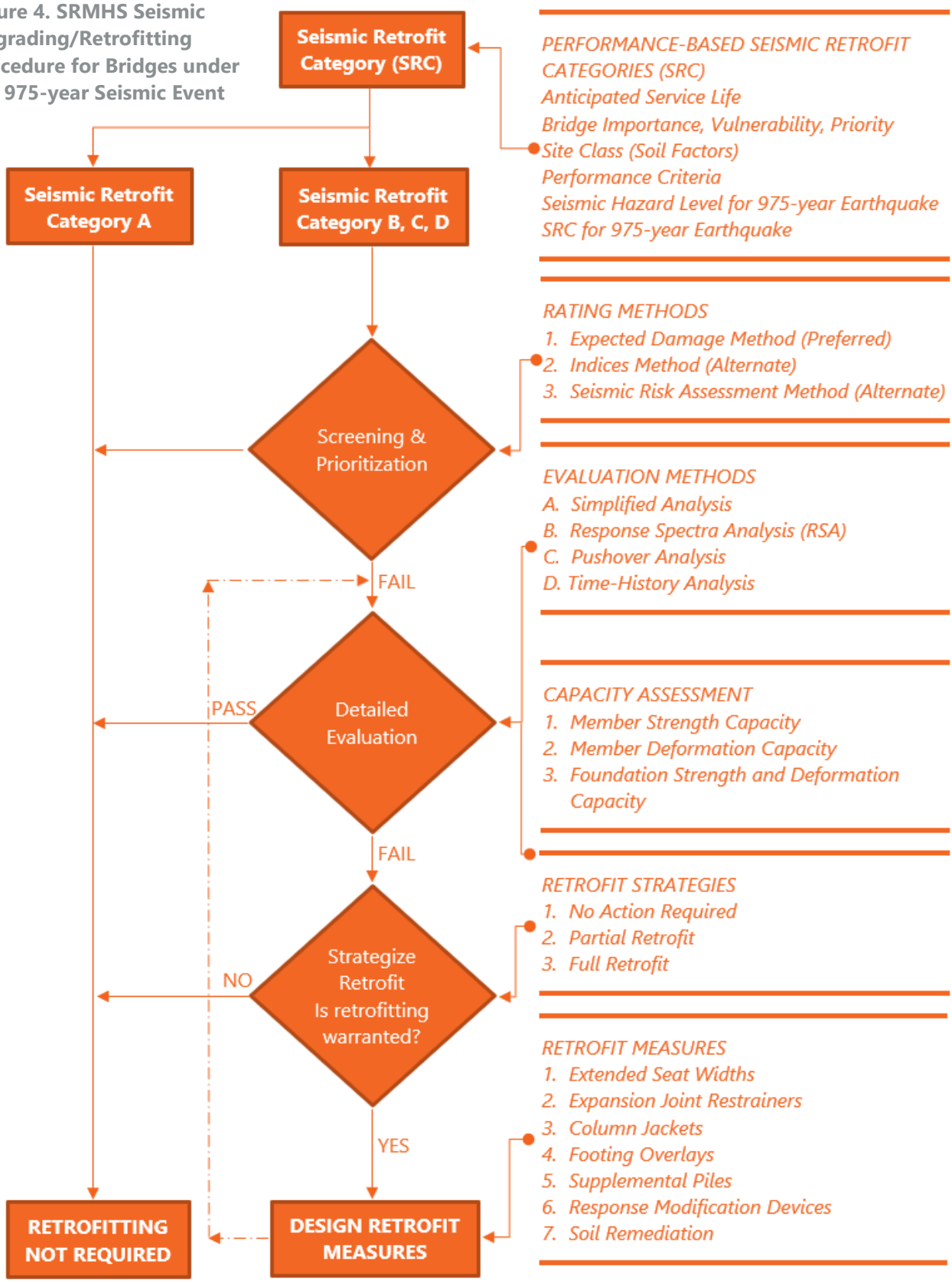
3.1.3 Priority Rating

Finally, the Priority Rating is determined by summing the Importance Rating with the Vulnerability Rating. Since both the Importance Rating and Vulnerability Rating values increase for higher seismic retrofit/upgrade priority, the structures with the highest Priority Rating are considered the highest priority for seismic retrofit/upgrade. The Priority Index then simply provides the ranking of the higher Priority Ratings, as shown in Table 8 and Table 9. Note that ties are assigned an equal Priority Index value.

3.2 Seismic Retrofit Category

The selection and costs of seismic upgrades/retrofits can vary significantly depending on a number of factors. The desired performance level, importance rating, and vulnerability rating all contribute to the selection of retrofit category, including the appropriate seismic evaluation methods, capacity assessment requirements, retrofit strategies, and retrofit measures, as illustrated in Figure 4. With seismic upgrades/retrofits prioritized per Section 3.1, a method for determining relative costs provides an additional decision-making metric to determine when a structure is to be seismically upgraded/retrofitted. This subsection describes the proposed method for qualitatively determining the seismic evaluation costs on a relative basis (Low – Moderate – High – Highest) for each structure based on the SRMHS framework.

Figure 4. SRMHS Seismic Upgrading/Retrofitting Procedure for Bridges under the 975-year Seismic Event



3.2.1 Performance Level

The performance level of a seismic retrofit defines the desired performance of the retrofitted structure during and after a seismic event of a given intensity. The performance level may be directly calculated using the SRMHS seismic retrofitting framework, which uses a structure's importance and vulnerability to determine its performance level. An important consideration of the SRMHS performance level is the age of the structure, with newer structures representing better candidates for seismic retrofit, and older structures representing better candidates for replacement. The performance level can also be modified based on engineering judgment at the District's discretion. Once the performance level is established, the expected level of analysis and types of component retrofits can be determined, though also subject to engineering judgment. The performance criteria and anticipated seismic retrofit category are defined for the performance levels in Table 10. As indicated in the table, the performance criteria of the seismic retrofit increase with increasing performance level, with PL0 requiring the least stringent performance criteria and PL3 requiring the most. The minimum requirements from the SRMHS framework for each seismic retrofit category are provided in Table 11, which also qualitatively lists the expected costs, ranging from "low" to "highest."

Table 10. Performance Level Categories and Corresponding Anticipated Seismic Retrofit Categories

Performance Level	Performance Criteria	Anticipated Seismic Retrofit Category
0 (PL0):	No minimum level of performance is recommended	**A**
1 (PL1):	Life Safety: Extensive damage is sustained during an earthquake and service is significantly disrupted, but life safety is assured. The bridge may require probable replacement after a large earthquake.	**B**
2 (PL2):	Limited: The bridge shall be usable for emergency traffic and be repairable without requiring bridge closure. At least 50% of the lanes, but not less than one, lane shall remain operational. If damaged, normal service shall be restored within a month.	**C**
3 (PL3):	Immediate Service: Minimal damage is sustained and full service is available for all vehicles after inspection and clearance of debris. Any damage is repairable without interruption to traffic.	**D**

Table 11. Seismic Retrofit Category Requirements and Relative Costs

Requirements		Seismic Retrofit Category			
		A (Low Cost)	B (Moderate Cost)	C (High Cost)	D (Highest Cost)
Global Strategy		-	Recommended	Required	Required
Identification SFRS		-	Recommended	Required	Required
Support Connections		Required	Required	Required	Required
Support Length		Required	Required	Required	Required
Demand Analysis		Simplified	Response Spectra	Pushover Analysis	Time-History Analysis
Ductility Requirements		-	Low	Medium	High
Capacity Protection		-	Recommended	Required	Required
P-Δ Effect		-	-	Required	Required
Retrofitting Components to be Retrofitted (If Deficient)	*Seats and Connections*	Not Required	Yes	Yes	Yes
	Columns, Walls, Footings	Not Required	Not Required	Yes	Yes
	Abutments	Not Required	Not Required	Not Required	Yes
	Liquefaction	Not Required	Yes	Yes	Yes

3.2.2 Hazard Level

A structure's hazard level is determined by the intensity of ground shaking in the rock below the site and the amplification of this motion by the overlying soils. The SRMHS framework uses the design response spectral acceleration values equivalent to those provided by CHBDC CAN/CSA Section 4.4.3.4 as S(1.0). The expected S(1.0) for all structures is expected to be Hazard Level III, as determined by the definitions provided in Table 12.

Table 12. Hazard Level Categories

Hazard Level	Spectral Acceleration (g)
I	$S(1.0) \leq 0.15$
II	$0.15 \leq S(1.0) \leq 0.35$
III	$0.25 \leq S(1.0) \leq 0.40$
IV	$0.40 \leq S(1.0)$

3.2.3 Anticipated Seismic Retrofit Category

The SRMHS framework leads to the proposed seismic retrofit category, which is summarized in Table 13. The bridges with asterisks are modified to reflect engineering judgment and account for additional concerns relating to the bridge structure and the condition of its components. The anticipated seismic retrofit category may be combined with the Priority Index of each structure to determine when it should be seismically upgraded/retrofitted on a relative basis. As indicated in Table 11, ascending letters represent higher expected seismic retrofit costs.

Table 13. Anticipated Seismic Retrofit Design Category Summary

Structure ID No.	Approx. Location	Priority Rating	Priority Index	Performance Level	Hazard Level	Anticipated Seismic Retrofit Category (ascending letters have higher expected costs)
101	420 Keith Rd	12	4	PL0	III	**D***
102	498 Inglewood Ave	6	12	PL1	III	**B**
103	3975 Marine Dr	10	7	PL1	III	**B***
104	North of Almondel Pl on Almondel Rd	6	12	PL2	III	**C**
105	4375 Marine Drive	15	2	PL0	III	**A**
106	North of Trans-Canada Hwy on Nelson Creek	16	1	PL0	III	**D***
107	Eagle Lake Rd on Cypress Creek	14	3	PL1	III	**B**
108	345 Keith Pl	11	5	PL1	III	**B**
109	1162 Millstream Rd	5	17	PL1	III	**B**
110	1310 Sinclair St	9	8	PL1	III	**B**
111	1620 Chippendale Rd	7	11	PL2	III	**C**
112	2458 Chippendale Rd	6	12	PL2	III	**C**
113	2306 Chippendale Rd	6	12	PL2	III	**C**
115	2817 Chippendale Rd	6	12	PL2	III	**C**
116	3032 Burfield Pl	5	17	PL2	III	**C**
401	5771 Eagle Harbour	9	8	PL0	III	**A**
402	5771 Eagle Harbour	11	5	PL0	III	**A**
403	5771 Eagle Harbour	8	10	PL0	III	**A**

*Anticipated Seismic Retrofit Category modified to reflect engineering judgment and account for additional concerns relating to the bridge structure and the condition of its components

Table 14. Anticipated Seismic Retrofit Design Category Summary – Sorted on a relative cost basis (this is not a prioritization ranking)

Structure ID No.	Approx. Location	Anticipated Seismic Retrofit Category (ascending letters have higher expected costs)
105	4375 Marine Drive	**A**
401	5771 Eagle Harbour	**A**
402	5771 Eagle Harbour	**A**
403	5771 Eagle Harbour	**A**
102	498 Inglewood Ave	**B**
107	Eagle Lake Rd on Cypress Creek	**B**
108	345 Keith Pl	**B**
109	1162 Millstream Rd	**B**
110	1310 Sinclair St	**B**
103	3975 Marine Dr	**B***
104	North of Almondel Pl on Almondel Rd	**C**
111	1620 Chippendale Rd	**C**
112	2458 Chippendale Rd	**C**
113	2306 Chippendale Rd	**C**
115	2817 Chippendale Rd	**C**
116	3032 Burfield Pl	**C**
101	420 Keith Rd	**D***
106	North of Trans-Canada Hwy on Nelson Creek	**D***

*Anticipated Seismic Retrofit Category modified to reflect engineering judgment and account for additional concerns relating to the bridge structure and the condition of its component.

4 Remaining Useful Life and Recommended Upgrade Life Cycle Timeline

The remaining useful life (RUL) described in the RFP, can be defined as the remaining period of time that a structure can be expected to perform its function for its intended use. The RUL can often be extended significantly through enhanced maintenance, remediation, and rehabilitation operations.

A default RUL can be determined by taking the structure's original "design life" and subtracting the time from its construction date to the current date. A structure's design life is defined by Section 1.3.3 of the CHBDC CAN/CSA S6-19 as the original period of time that a structure is expected to perform its function for its intended use. Section 1.4.2.3 in the CHBDC CAN/CSA S6-19 states that all new structures shall be designed for a 75-year design life, unless otherwise approved, which is a requirement that has been carried forward from the CHBDC CAN/CSA S6-14 and CHBDC CAN/CSA S6-06 codes. Earlier versions of the bridge code were based on the Ontario Highway Bridge Design Code (OHBDC 1983, 1991), which did not explicitly state a required design life. Therefore, the structures constructed after 2006 (Structure ID's: 104, 115, 116, 401, 402, 403) may be expected to have an original design life of 75 years, whereas the remaining structures do not have a well-defined design life.

Even for structures with defined original design lives, the RUL will vary from code-prescribed values due to a variety of factors. Environmental factors (e.g. applications of road salts, snow buildup, freeze-thaw), bridge use (e.g. traffic volumes), construction issues (e.g. deficient materials, poor construction), and maintenance schedule (e.g. regular versus irregular) can all affect the RUL of a structure. Due to these unknowns, for this report, all structures have a default assumed original design life of 75 years upon completion of construction, but structures with default RULs under 25 years have final RULs that have been modified with a high degree of judgment based on the 2022 Inspection findings.

The recommended upgrade life cycle timeline is based on an assumed replacement or rehabilitation schedule for different structural and non-structural components over the lifespan of the bridge. The timeline uses typically-assumed lifespans for each component as well as modified values based on TYLin's inspection findings and experience with these components.

The Remaining Useful Life and Recommended Upgrade Life Cycle Timeline are provided both in Appendix A and Table 15 for convenience.

Table 15. Remaining Useful Life and Recommended Upgrade Life Cycle Timeline

Struct ID	Approx. Location	Remaining Useful Life	Recommended Upgrade Life Cycle Timeline (Estimated Approximate Years into the Future)
101	420 Keith Road	5	Barrier Retrofit (<5 yrs) Seismic Retrofit (<5 yrs) – this will confirm pier retrofit importance Recoating of Painted Timber Railings and Barriers (<5 yrs) Resurface Bridge Deck and Approaches (~10 yr)
102	498 Inglewood Avenue	38	Resurface Bridge Deck and Approaches (~5 yr) Reposition or Add Riprap to Embankments (~10 yr)
103	3975 Marine Drive	20	Resurface Bridge Approaches (~15 yr) Recoat Girders and Steel Diaphragms (~20 yr) Bearing Replacement (~20 yr)
104	North of Almondel Pl on Almondel Rd	61	Resurface Bridge Approaches (~10 yr) Recoat Girder near Abutment (~16 yr) Bearing Replacement (~16 yr)
105	4375 Marine Drive	10	Resurface Bridge Approaches (~10 yr) Recoat Girders and Steel Diaphragms (~10 yr) Bearing Replacement (~10 yr) Strengthen Utility Connections (~10 yr)
106	North of Trans-Canada Hwy on Nelson Creek	9	Potential Concrete Deck Removal and Replacement with Lighter Structure (<5 yr) Potential Rehabilitate and Recoat Highly-Corroded Elements (<5 yr) Potential Retrofit of Select Bridge Components (<5 yr) Potential Replacement of Bridge (<5 yr)
107	Eagle Lake Rd on Cypress Creek	37	Resurface Bridge Deck and Approaches (<5 yr) Recoat Girders (~10 yr) Bearing Replacement (~10 yr)
108	345 Keith Pl	19	Resurface Bridge Approaches (~5 yr) Recoat Girders and Steel Diaphragms (~10 yr) Bearing Replacement (~10 yr)
109	1162 Millstream Rd	17	Resurface Bridge Approaches (~15 yr)

Struct ID	Approx. Location	Remaining Useful Life	Recommended Upgrade Life Cycle Timeline (Estimated Approximate Years into Future)
110	1310 Sinclair St	48	Reposition or Add Riprap to Embankments (~10 yr) Resurface Bridge Approaches (~20 yr)
111	1620 Chippendale Rd	55	Resurface Bridge Deck and Approaches (~5 yr) Bearing Replacement (~15 yr)
112	2458 Chippendale Rd	57	Resurface Bridge Deck and Approaches (~15 yr) Bearing Replacement (~15 yr)
113	2306 Chippendale Rd	57	Resurface Fill Above Culvert and Approaches (~20 yr) Coat Interior of Culvert Pipe (~20 yr)
115	2817 Chippendale Rd	63	Resurface Bridge Deck and Approaches (~15 yr) Bearing Replacement (~15 yr)
116	3032 Burfield Pl	67	Resurface Bridge Deck and Approaches (~25 yr) Bearing Replacement (~25 yr)
401	5771 Eagle Harbour	15	Shim Bearing Seats Above Each Pier (~5 yr) Re-deck Float (~10 yr) Re-deck Pier (~15 yr) Bearing Replacement (~25 yr)
402	5771 Eagle Harbour	15	Shim Bearing Seats Above the Pier (~10 yr) Re-deck Float (~15 yr) Re-deck Pier (~20 yr) Bearing Replacement (~25 yr)
403	5771 Eagle Harbour	15	Re-deck Float (~15 yr) Re-deck Pier (~20 yr) Bearing Replacement (~25 yr)

5 Recommended Five-Year Remediation and Rehabilitation Program

TYLin has developed a recommended five-year remediation and rehabilitation program based on the 2022 Inspection findings in combination with past reports and studies. The specific recommended remediation and rehabilitation items, and their associated cost estimates, are provided in Table 16. The cost estimate totals are provided with a 10% allowance for engineering services and a 20% cost contingency to account for the significant current fluctuations in labour and material costs. It should be noted that the remediation and rehabilitation items are recommended based on the design guidelines for new bridges and marine piers. Therefore, some recommended non-structural items, such as signage, barriers, crash attenuators, aesthetic recoating work, and pavement resurfacing are considered optional based on the District's preference and risk tolerance. Other items regarding structural or geotechnical deterioration or deficiencies should be considered as having higher importance.

Also included in Table 16 is the recommended cost allocation schedule for the next five budget years. The recommended cost allocation schedule is based on the following criteria:

- Priority based on a remediation or rehabilitation item's importance, i.e. using the Overall and Component Urgency Ratings;
- Assuming all repairs at one structure will occur at the same time, i.e. no multiple mobilization and demobilization costs; and,
- Performance-related deficiencies are prioritized over material-related defects.

The cost allocation schedule also attempts to spread the costs as evenly as possible, with the first three years being front-end loaded with higher expenditures compared to the subsequent two years. The first three years include recommended load rating analysis, barrier capacity analysis, seismic assessment, and retrofit studies since the results of these studies may result in deficiencies that may require a longer budgeting timeframe.

The two structures with recommended studies are the Keith Road Bridge (Structure ID: 101) and the Nelson Canyon Bridge (Structure ID: 106). The Keith Road Bridge had a previous RFP released in 2019 with a bridge replacement scope, while the Nelson Canyon Bridge had an Expression of Interest with a demolition and replacement scope released in 2018. TYLin understands that these two structures had been previously identified for replacement due to concerns regarding their seismic vulnerability. TYLin recommends that the District consider updated seismic retrofit options and cost estimates based on the 2022 Inspection findings and assessments of their seismic vulnerabilities for current seismic hazard demands.

TYLin believes that based on the 2022 Inspection findings, these structures each have a number of highly-viable seismic retrofit options available that may be more desirable than relatively costly replacement options. For the Nelson Canyon Bridge, TYLin identified that both the gravity and seismic load-carrying systems could be relieved of significant demands by removing the existing concrete

deck (accounting for ~85% of the gravity and seismic mass) and replacing it with an economical partial-width timber deck (3-4 m-wide relative to the existing 10 m-wide deck) that could accommodate both the watermain and pedestrian and maintenance vehicle traffic. The top flanges of the floorbeams and girders may also be prudent to elongate the lifespans of these elements, which are now more exposed to the elements. Rocking connections at the base of the pier legs could also be included to protect the spread footing foundations and elongate the period of the structure, reducing its seismic demands further. Similarly, rocking foundation technology could be applied to the Keith Road Bridge to remove seismic demands from the relatively weak pier legs, which could also be concrete- or steel-jacketed to increase their capacity. Rocking connections in particular have proven to be a cost-effective solution for seismically-deficient pier legs both internationally and locally, such as on the approach spans to the Lions Gate Bridge, as shown in Figure 5.

Since the pier legs are believed to be the catalyst for the potential replacement of both the Nelson Canyon and Keith Road Bridges, performing cost-effective retrofits to these elements can elongate the remaining useful life of the existing structures because the rest of the structural elements on these bridges are in fair to good condition. Both the Nelson Canyon and Keith Road Bridges are anticipated to have remaining useful lives of at least 20 years if the pier legs were seismically retrofitted or if seismic analysis finds that they are adequate for the applied seismic demands.

Figure 5. Typical Rocking Connection Components on the Lions Gate Bridge Approach Spans

As requested by the District, high-level estimated construction costs are provided below for the Nelson Canyon and Keith Road Bridges. These costs should not be relied upon as no seismic analysis has been conducted to confirm their validity, but instead they serve as "ballpark" figures for comparative analysis. These costs are based on similar work items conducted on other recent projects with similar scope to what is anticipated for the proposed retrofit measures. Detailed cost estimates could be provided separately at the District's request.

The proposed retrofit measures of rocking connections in conjunction with concrete deck removal, partial-width timber decking and railing installation, recoating of the floorbeam and girder top flanges, and realignment of the water main for the Nelson Canyon Bridge have an estimated construction total cost of approximately $900,000 CAD. If rocking foundations are found not to be required following seismic analysis, this cost may be lowered to an estimate of approximately $650,000 CAD. Alternatively, if rocking foundations are determined to be sufficient to accommodate the applied seismic demands without deck removal, the construction costs could be lowered to an estimated approximate $250,000 CAD. The cost of engineering services for this retrofit work is expected to be covered by the studies proposed for this bridge in Table 16.

TYLin would also like to introduce the idea of two alternative options for replacement bridges approximately 15 m downstream of the existing bridge, taking advantage of rock outcrops in the canyon walls, reducing foundation costs, lessening the bridge span length, avoiding interference with the BC Hydro powerlines, simplifying construction staging, and minimizing any realignment of the existing watermain.

The first option would be a 55 m-long glulam underdeck arch bridge at an elevation approximately 5 m below the existing deck level. The glulam arch would be treated with CCA/CZA, providing a design life of at least 50 years while being light-weight for assembly on the existing bridge, environmentally friendly to sensitive fish habitats along Nelson Creek, and utilizing wood's minimal embodied carbon to reduce the environmental footprint of the structure. The arch ribs could be sourced from Western Canada, including fabricators in Kelowna, Castlegar, and Edmonton, while the remaining structural elements could be sourced locally from Metro Vancouver. A basic rendering of this bridge concept is provided in Figure 6. The estimated construction costs for this structure would be approximately $1,200,000 CAD, with an engineering services allowance of $350,000 CAD. These estimates do not include any demolition work of the existing bridge structure.

Figure 6. Arch Bridge Alternative Bridge Replacement Option

The second option would also be approximately 55 m-long and at an elevation approximately 5 m below the existing deck level, but instead be a suspension bridge for only the watermain pipeline and its associated maintenance access. The structure would consist of short towers at each abutment with twin suspension cables attached to the watermain pipeline and a small maintenance access walkway above. This structure minimizes construction costs by eliminating materials that would be required for general pedestrian and maintenance vehicle access. The structure would have a design life of at least 75 years and likely be galvanized to reduce maintenance requirements. Due to the removal of general pedestrian access, TransCanada Trail users would be directed to a new 750 m-long trail route that must be cut along the west bank of Nelson Canyon. This trail would be on relatively rough terrain and link to a very small pedestrian bridge near the TransCanada Trail intersection with the Whyte Lake Trail; however, District Staff may be able to cut this trail and build this small bridge in-house. Given the relatively low number of trail users going between Seaview Trail to the southwest of the existing bridge to the Whyte Lake Trail parking lot to the southeast, the loss of pedestrian access at the bridge location is not anticipated to be significant. The proposed trail-cutting requirements for this option are provided in Figure 7. The estimated construction costs for this structure would be approximately $700,000 CAD, with an engineering services allowance of $250,000 CAD. These estimates do not include any demolition work of the existing bridge structure.

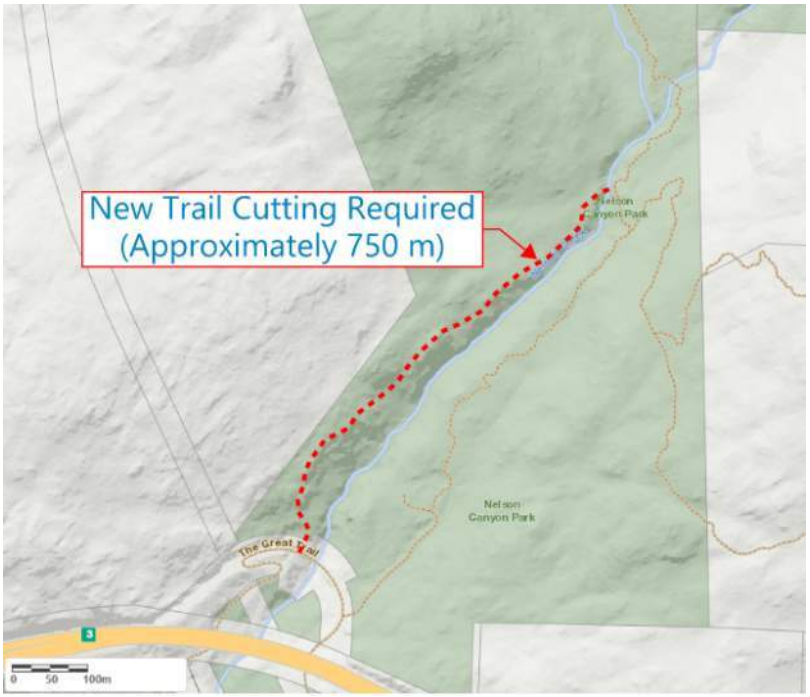


Figure 7. Pipeline-Only Alternative Bridge Replacement Option's Trail-Cutting Requirements (Credit: Map source from WestMap by the District of West Vancouver)

For the Keith Road Bridge, if seismic analysis determines that rocking foundations in conjunction with pier leg jacketing are suitable retrofit measures for the structure, the estimated total construction costs for the retrofit work would be approximately $225,000 CAD. The cost of engineering services for this retrofit work is expected to be covered by the studies proposed for this bridge in Table 16.

Also included in Table 16 for convenience are the recommended annual routine maintenance item estimated approximate cost totals. These costs are also provided in greater detail in Appendix A and in Table 6. At the request of the District, TYLin has provided an alternative strategy to resealing deck cracks in the asphalt roadways of integral or semi-integral bridges, which make up all of the bridges in the inspection program. The proposed strategy is to sawcut the asphalt road surface in a straight line directly above the end of the concrete deck across the full breadth of the roadway asphalt using a wheeled concrete saw. For unskewed bridge decks, this line will likely be perpendicular to the bridge centreline, whereas for skewed bridge decks, this line will likely be on a non-perpendicular angle to the bridge centreline. The saw should cut along this line to form a groove with a depth of 20 mm and a width of 20 mm, as shown in Figure 8. Following the sawcut work, the groove should be thoroughly cleaned of any debris with a wire-brush, and a 22 mm (7/8")-diameter foam backer rod should be packed into the bottom of the groove. Crafco Roadsaver 221, or an approved equivalent product from the Rubberized and Elasticized Crack Sealants section of the latest BC MoTI Recognized Products List, should then be injected into the groove following the manufacturer's specifications and recommendations, leaving a 3 mm concave surface at deck level to allow for thermal expansion volume changes of the sealant. This detail has been used successfully on a number of recent projects and has been noted to perform well in achieving its objective of concentrating thermal cracking in the asphalt approaches along the sawcut groove instead of cracking over a distributed area on the bridge approaches, which often leads to user rideability issues. The costs associated with the proposed strategy are expected to be similar to the approximate costs included in Table 6 for resealing the deck joints, and are therefore recommended.

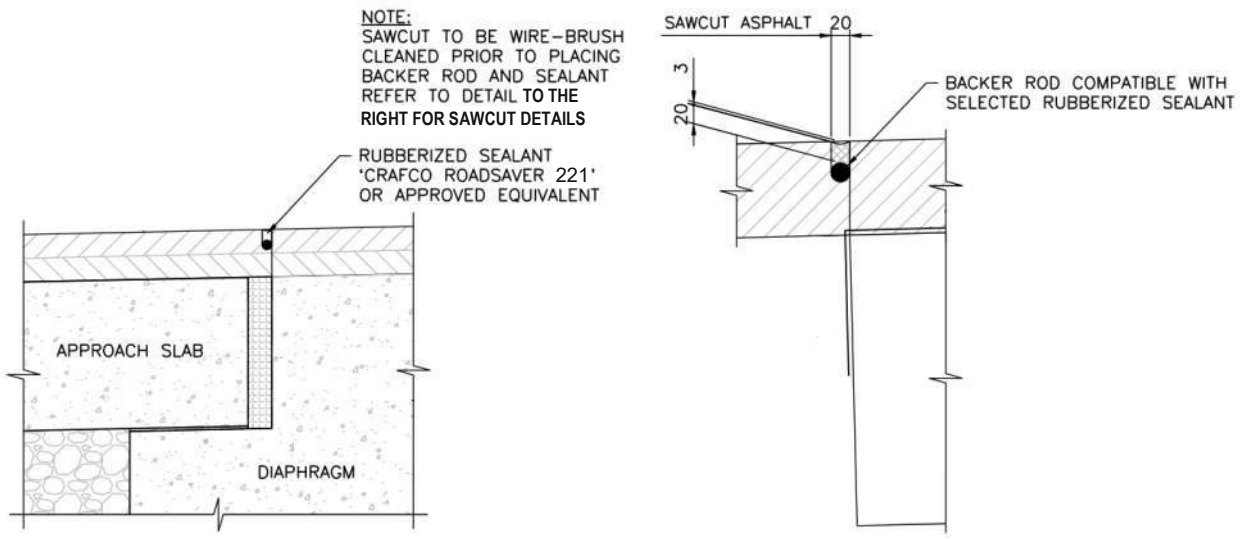


Figure 8. Proposed Alternative Strategy to Resealing Asphalt Deck Joints on Integral and Semi-Integral Bridges

Table 16. Total Annual Maintenance Costs and 5-Year Remediation and Rehabilitation Program Costs and Recommended Allocation Schedule

Struct ID	Approx. Location	Total Annual Routine Maintenance Costs (CAD)	5-Year Remediation and Rehabilitation Program Costs and Recommended Cost Allocation Schedule (CAD)					
			Remediation and Rehabilitation Items	2022	2023	2024	2025	2026
101	420 Keith Road	7,500	1. Load Rating Analysis Study	20,000				
			2. Barrier Capacity Analysis Study	7,500				
			3. Seismic Assessment Study		20,000			
			4. Retrofit Options Study		75,000			
102	498 Inglewood Avenue	7,500	1. Resurface Expansion Joint Pavement at both Abutments					10,000
			2. Replace Pipe Hanger Components and Damage to Pipes					7,000
			3. Add Delineator and Bicyclist Dismount Signs					2,000
			4. Add TAC Barrier Flares or Crash Attenuators					9,000
			5. Improve Riprap Protection on East Embankment at Pipe Outfall					10,000
103	3975 Marine Drive	7,500	1. Perform Localized Girder Recoating and Spall Repairs			20,000		
			2. Reinstall Road Barriers per the Original Retrofit Design			25,000		
			3. Repair Pipe Line Protection			7,500		
			4. Add TAC Barrier Flares or Crash Attenuators			5,000		
			5. Add Delineator Signs and Bicyclist Dismount Signs			1,500		
104	North of Almondel Place on Almondel Road	6,500	1. Repair (2) Railing Balusters on Northwest Bridge Approach				1,500	
			2. Perform Localized Railing Recoating				1,500	

Struct ID	Approx. Location	Total Annual Routine Maintenance Costs (CAD)	5-Year Remediation and Rehabilitation Program Costs and Suggested Cost Allocation Schedule (CAD)					
			Action Item	2022	2023	2024	2025	2026
105	4375 Marine Drive	6,500	1. Inject and Seal Abutment, Wing Wall, Parapets Joints/Cracks				4,000	
			2. Install Riprap at Southeast Footing Corner				2,500	
			3. Perform Localized Girder Recoating and Spall Repairs				15,000	
			4. Add Bicyclist Dismount Signs on Sidewalks				1,000	
			5. Add TAC Barrier Flares or Crash Attenuators				5,000	
106	North of Trans-Canada Hwy on Nelson Creek	14,000	1. Load Rating Analysis Study	30,000				
			2. Seismic Assessment Study	125,000				
			3. Retrofit Options Study		125,000			
107	Eagle Lake Road on Cypress Creek	5,000	1. Remove Abutment and Deck Debris Build-up				2,500	
			2. Relash Support Logs at both Abutments				2,500	
			3. Perform Localized Girder and Pipe Support Recoating				10,000	
			4. Replace Bracing Connection Bolts				2,500	
			5. Add TAC Barrier Flares or Crash Attenuators				10,000	
108	345 Keith Place	6,500	1. Recoat Bottom Flanges and Bearing Stiffeners of Girders			125,000		
			2. Repair Deck Panel Joints on Widewalk Overhang			10,000		
			3. North Expansion Joint Pavement Resurfacing			5,000		
			4. Add Delineator and Bicyclist Dismount Signs			2,000		
			5. Add TAC Barrier Flares or Crash Attenuators			9,000		
109	1162 Millstream Road	6,000	1. Perform Localized Spall Repairs on Abutments					3,000
			2. Perform Localized Spall Repairs on Girder Webs					3,000
			3. Add Bicyclist Dismount Signs					1,000

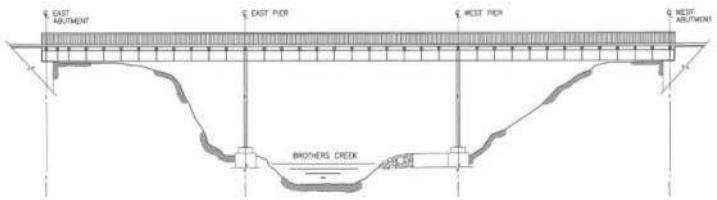
Struct ID	Approx. Location	Total Annual Routine Maintenance Costs (CAD)	5-Year Remediation and Rehabilitation Program Costs and Suggested Cost Allocation Schedule (CAD)					
			Action Item	2022	2023	2024	2025	2026
110	1310 Sinclair Street	5,500	1. Replace Shifted Riprap, Particularly at Southeast Corner					10,000
			2. Add Delineator Signs					1,000
			3. Reattach Kickplate at Southeast Corner of Bridge Railing					500
			4. Add TAC Barrier Flares or Crash Attentuators					9,000
111	1620 Chippendale Road	6,500	1. Perform Localized Spall Repairs to Deck Soffit					10,000
			2. Perform Localized Spall Repairs on Girder Flange					5,000
			3. Protect/Regrade Edges of Shotcreted West Embankment					7,500
			4. Bicyclist Dismount Signs					1,000
			5. Add TAC Barrier Flares or Crash Attentuators					10,000
112	2458 Chippendale Road	6,500	1. Perform Localized Spall Repairs to Deck Overhang Soffit					5,000
			2. Add Delineator and Bicyclist Dismount Signs					2,000
113	2306 Chippendale Road	4,500	1. Regrade Substrate in Culvert to Reduce Fish Obstacles	10,000				
			2. Rebolt Multi-Plate Connections at Inlet	2,000				
115	2817 Chippendale Road	6,500	1. Add/Adjust Riprap to Better Protect Embankment Slopes					5,000
			2. Add Delineator and Bicyclist Dismount Signs					2,000
			3. Add TAC Barrier Flares or Crash Attenuators					5,000

Struct ID	Approx. Location	Total Annual Routine Maintenance Costs (CAD)	5-Year Remediation and Rehabilitation Program Costs and Suggested Cost Allocation Schedule (CAD)					
			Action Item	2022	2023	2024	2025	2026
116	3032 Burfield Place	6,500	1. Add/Adjust Riprap to Better Protect Embankment Slopes					5,000
			2. Add TAC Barrier Flares or Crash Attenuators					12,000
			3. Inject and Seal Abutment, Wing Wall, Parapets Joints/Cracks					2,500
			4. Bicyclist Dismount Signs					1,000
401	5771 Eagle Harbour	7,000	1. Re-deck Float Deck Adjacent to Ramp and Add Pile Slider				7,500	
			2. Reapply Blackout Paint for Deck Lighting				1,000	
			3. Reposition or Replace Bearing Pins at Aluminum Ramp				2,000	
			4. Realign Pier 4 Footing and Cap				20,000	
			5. Replace Pier Bracing at All Piers and Grout All Pier Pedestals				15,000	
			6. Timber drilling test using Haglof incremental boring probe				2,000	
402	5771 Eagle Harbour	5,000	1. Remove Excess Corrosion at Piles and Coat or Add Anodes				2,500	
			2. Perform Localized Redecking on Float				2,500	
			3. Repair Pile Sliders at (2) Locations				1,500	
403	5771 Eagle Harbour	3,000	1. Reposition or Replace Bearing Pins at Aluminum Ramp				1,000	
			2. Perform Localized Redecking on Float				1,000	
			Estimated Approximate 5-Year Remediation and Rehabilitation Program Annual Cost Totals (CAD) =	**194,500**	**220,000**	**210,000**	**114,000**	**138,500**
			+20% Contingency and +10% Engineering Services (CAD) =	**252,850**	**286,000**	**273,000**	**148,200**	**180,050**
			Estimated Approximate 5-Year Remediation and Rehabilitation Program Total Cost (CAD) =		**1,140,100**			
			Estimated Approximate Total Cost of Annual Maintenance Program (CAD) =		**118,000**			
			+20% Contingency and +10% Engineering Services (CAD) =		**153,400**			

Appendix A

STRUCTURE ID: 101 – KEITH ROAD OVER BROTHERS CREEK **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	1952	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Keith Road	
FEATURE CROSSED:	Brothers Creek	
SUBSTRUCTURE:	Abutments - Spread footings East Pier: - Spread footing with braced steel lattice columns West Pier: - Concrete pedestal with braced steel lattice columns	
SUPERSTRUCTURE:	Steel plate girders with timber and steel transverse floor beams supporting timber stringers and timber decking	
WEARING SURFACE:	2-Lane composite timber and reinforced concrete deck	
APPROACHES:	Bridge is in straight-alignment with Keith Road	
GENERAL:	SPANS:	3-span: 17.7m, 17.5m, 17.6m
	TOTAL LENGTH:	52.8m
	DECK AREA:	354m2
	BEARINGS:	Steel
	BANK/PIER PROTECTION:	Concrete pedestal at west pier
	GUARDRAIL:	Timber
	CURB:	Timber curb rail
	UTILITIES	Gas; Watermain
	CLEARANCE:	5m
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Gas Pipeline; Fish-bearing Stream; No-Dumping
SEISMIC ASSESSMENT:	2006: Conceptual seismic assessment	
DIAGNOSTIC TESTING/STUDY:	2006: Load Rating	
PAST REHABILITATION WORKS:	1994: Watermain and hangers relocated 1996: West Pier foundation footing scour repaired 2002: Column strengthening to West Pier and East Pier 2007: Deck strengthening – installation of transverse steel beams 2019: RFP Issued for New Bridge Design	

OVERALL CONDITION:	Fair Condition, but potential significant deficient capacities – Urgency Rating = 4
ESTIMATED REMAINING SERVICE LIFE:	5 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Barrier Retrofit (<5 yr) 2. Seismic Retrofit (<5 yr) 3. Recoating of Painted Timber Railings and Barriers (<5 yr) 4. Resurface Bridge Deck and Approaches (~10 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Load Rating Analysis Study (~$20,000) 2. Barrier Capacity Analysis Study (~$7,500) 3. Seismic Assessment Study (~$20,000) 4. Retrofit Options Study (~$75,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$2,000; no associated specification). 4. Spot Overcoating Timber Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers; however, surface preparation standards may be relaxed to account for timber rather than steel materials). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively.

westvancouver | TYLin

BRIDGE CONDITION INSPECTION

Inspection Type
☑ Routine ☐ Partial
☐ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
101	Keith Road Over Brothers Creek	9/5/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.
1	Debris Risk		100						R	Good elevation/protection of both piers.
2	Channel			70	30				R	Channel is confined on the west bank by the existing and original west pier footings.
3	Erosion Protection		40	60					R	Piers are generally well protected from erosion due at the creek.
4	Substructure Scour			109					R	No concerning scour present.
	SUBSTRUCTURE									
5	Foundation Movement			100					R	No visible evidence of significant foundation movement.
6	Abutments		30	70					R	Abutments in generally good-fair condition.
7	Wing/Retaining Walls			100					R	Retaining walls in fair condition.
8	Embankment			50	50				2	Both embankments vulnerable to erosion, especially at east pier.
9	Footings/Piling			75	25				4	Generally fair condition, although southeast tower leg completely buried.
10	Pier Columns/Walls/Cribs			60	25	15			3	Heavy corrosion on lower portions of the west pier, particularly on the north leg.
11	Bearings			50	50				2	Abutment bearing plates in poor condition but not significant negative effects.
12	Caps			100					R	Abutments and piers cast directly on bedrock.
13	Corbels							N		
14	Dolphins/Fenders			75	25				R	Pedestrian railing, acting as a fender for the west pier, in fair-poor condition.
	SUPERSTRUCTURE									
15	Floor Beams/Transoms		30	70					R	430x295 Creasote floorbeams in generally good-fair condition.
16	Stringers			100					R	Sidewalk stringers in generally fair condition where visible.
17	Girders		30	60	10				1	Girders are generally good-fair except the flanges at the abutments.
18	Portals							N		
19	Bracing/Diaphragms		20	70	10				1	Generally good fair condition except at the connections.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							X		
25	Panels							X		
26	Pins/Bolts/Rivets		25	50	25				1	Generally in good-far condition outside of the abutment locations.
27	Camber/Sag			100					R	Minor camber/sag issues, but not to a significant degree.
28	Live Load Vibration		100						R	No significant vibration.
29	Coating (structure)			80	20				1	Generally fair except isolated locations on piers and connections.
	DECK									
30	Sub Deck/Cross Ties		5	90	5				R	No significant deterioration noted.
31	Wearing Surface		25	50	25				1	Wearing surface generally fair except at the joint locations.
32	Deck Joints		25	50	25				2	Expansion joints at abutments appear small given the length of bridge.
33	Curbs/Wheelguards			60	40				3	Timber curbs with 2x8 top rail, 1220 deck edge railing height, 1260 on road.
34	Sidewalk(s)			85	15				3	Decay noted at some connections, but generally fair condition overall.
35	Railings/Parapets			40	30	30			3	
36	Median Barrier							X		
37	Drains/Pipes							X		
38	Coating (Railings)			50	50				3	
	APPROACHES									
39	Signing/Lighting			100					R	
40	Roadway Approaches		100						R	
41	Roadway Flares				100				3	

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

4

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineator signs present on all four corners of the bridge. Gas Pipeline sign on both south corners of the bridge. No-Dumping signs also present on both south corners of the bridge. Trail sign indicating a fish-bearing stream at the northwest corner of the bridge.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has relatively low gradient.

Scour Notes

No active scour from the creek flow is affecting the pier or abutment foundations; however erosion scour is affecting the east pier legs, which are inundated with erosion debris.

Rehab Work Notes

Due to potential replacement is under consideration, only alternative load rating and seismic assement studies are recommended at this time. Potential retrofit options could include jacketing the corroded portions of the pier legs and convert the pier leg connections to rocking foundations to decrease global demands on the structure. Additional bracing could also be considered to improve the lateral load-carrying capacity of the pier legs. Permanent protection of the east pier legs from debris accumulation is recommended to prevent deterioration of those connections. Repair or strengthening of the road barriers and pedestrian fences is recommended. Strengthen existing bridge barriers to meet code requirements (using the CSA S6-19 TL-1 Barrier demands as a minimum design level). In general, the bridge superstructure is in fair condition, with significant remaining service life, whereas the piers have sustained past deterioration and may be vulnerable to seismic loading. Thus, this bridge may be a good candidate for seismic retrofit since the retrofit measures may be focused on the substructure, while leaving the superstructure as-is. This creates significant potential for cost benefits when compared to a bridge replacement option, where the entire structure would be demolished and a new structure built.

Maintenance Work Notes

Remove debris around pier and abutment bearing connections. Repaint road barriers and pedestrian fences is recommended for aesthetics.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in fair condition. The pier legs have experienced significant past pitting corrosion, but this has been largely arrested by recoating the steelwork. Debris accumulation is present at all pier and abutment locations, but particularly at the east pier connections, leading to more advanced corrosion action. Existing bridge barriers/railing appear as though they may not meet current code minimum strength requirements. The pier leg corrosion is significant, but appears to be relatively stable based on the findings from previous inspection reports. Nonetheless, further investigation is recommended in the near future to confirm the capacity of the bridge piers for both live loads and seismic loading.

Additional Utility Concern Notes

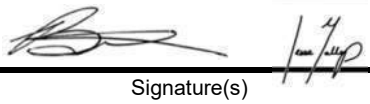
Existing watermain support elements are likely not sufficient to meet current seismic code requirements.

Additional Urgency Rating Notes

It appears that there been no load rating completed since the 2007 retrofit of the deck structure. Therefore, it is difficult to accurately assess the gravity load capacity of the structure; however, the existing structural condition does not appear to have deteriorated to an extent that would affect the capacity of the retrofitted structure. The seismic vulnerability of the structure is relatively high, primarily due to its weak pier legs.

Seismic Vulnerability Notes

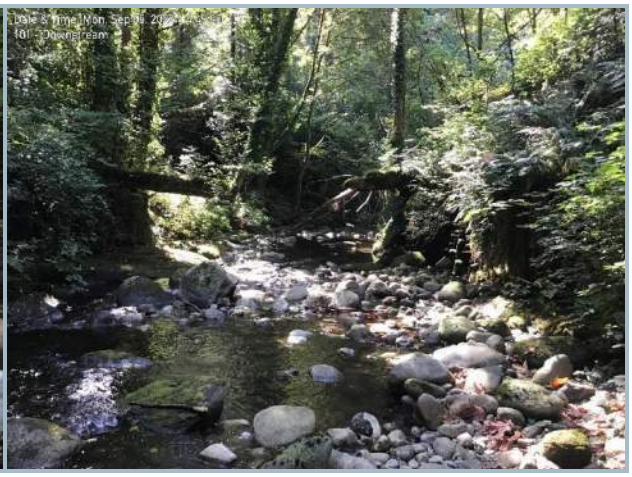
The seismic force-resisting system (SFRS) is expected to be ineffective at resisting most significant seismic demands and therefore should be considered a candidate for retrofit. The existing pier legs, bracing, and connections are the element of the SFRS that are expected to be the most vulnerable to seismic forces.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 101 – KEITH ROAD OVER BROTHERS CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. Upstream



002. Downstream

003. North Elevation Viewing East

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 101 - KEITH ROAD OVER BROTHERS CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. West Pier Abutment

010. East Pier Abutment

011. Bridge Deck Viewing West

012. Bridge Soffit Viewing East

STRUCTURE ID: 101 - KEITH ROAD OVER BROTHERS CREEK **DATE:** 09/05/2022

CONFIGURATION

013. Retrofit Installation of Transverse Steel Elements Bearing on Riveted Steel Plate Girders

014. Pedestrian Walkway along North Elevation

015. Barrier Bearing on Southwest Wingwall (Note Minor Undermining)

016. Watermain Utility along North Elevation (Note: Surface Corrosion of Pipe)

017. Gas Utility at Southeast Section of East Abutment

018. Utility Transversely Crossing West Abutment (Note Timber Deck)

STRUCTURE ID: 101 - KEITH ROAD OVER BROTHERS CREEK **DATE:** 09/05/2022

SEISIMIC FORCE REISISTING SYSTEM

019. Braced Pier Frame and Lateral Diagonal Bracing of Longitudinal Plate Girders, Typ.

020. Anchored Bearing Plate Connection, Typ.

021. Cross-Bracing Elements of Riveted Steel Plate Girders, Typ.

022. Anchored Pier Footing Connection, Typ.

023. Bolted Connection of Transverse Timber Elements

STRUCTURE ID: 101 - KEITH ROAD OVER BROTHERS CREEK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES

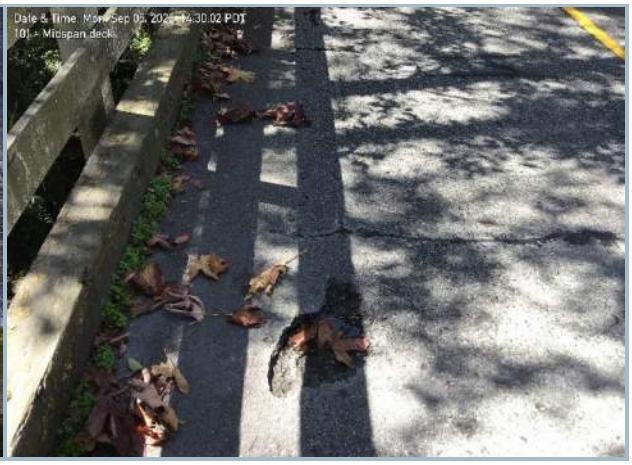
024. Pitting and Crevice Corrosion at West Pier Lattice, Typ.

025. Buried Southeast Pier Footing (Note Corrosion-led steel delamination)

026. Buried Bearing Plate at East Abutment

027. Debris accumulation at Pier Connections, Typ.

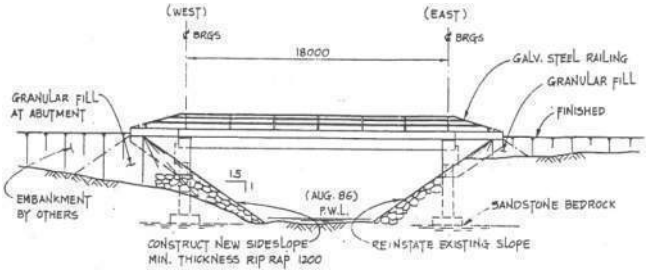
028. Decaying Timber Rail and Curb Components



029. Cracking on Asphalt Wearing Surface, Typ.

STRUCTURE ID: 102 – INGLEWOOD ROAD OVER BROTHERS CREEK **DATE:** 09/08/2022

DESCRIPTION



CONSTRUCTION DATE:	1986	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Inglewood Road (East of Taylor Way)	
FEATURE CROSSED:	Brothers Creek	
SUBSTRUCTURE:	Abutments – semi-integral reinforced concrete spread footings with wing-walls	
SUPERSTRUCTURE:	Prestressed concrete box girders with a cast-in-place concrete deck	
WEARING SURFACE:	2-Lane asphalt surface	
APPROACHES:	Bridge is in straight-alignment with Inglewood Road	
GENERAL:	SPANS:	1-span: 18.0m
	TOTAL LENGTH:	18.0m
	DECK AREA:	198m^2
	BEARINGS:	20mm elastomeric bearing
	BANK/PIER PROTECTION:	Riprap aprons
	GUARDRAIL:	Galvanized steel
	CURB:	Integrated cast-in-place
	UTILITIES	Watermain
	CLEARANCE:	4m
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Fish-Bearing Stream; Single-File
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	1997: Asphalt cracking repair; approach resurfacing; damage to railing on north side repaired 2000: Repair to chain-link fence and post, modification to bridge handrail 2013: Repairs to east abutment backfill due to watermain break and washout	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	38 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~5 yr) 2. Reposition or Add Riprap to Embankments (~10 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Resurface Expansion Joint Pavement at both Abutments (~$10,000) 2. Replace Pipe Hanger Components and Damage to Pipes (~$7,000) 3. Add Delineator and Bicyclist Dismount Signs (~$2,000) 4. Add TAC Barrier Flares or Crash Attenuators (~$9,000) 5. Improve Riprap Protection on East Embankment at Pipe Outfall (~$10,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Clean Vegetation from Deck Overhangs (~$1,500; no associated specification). 4. Clean Debris from Bearing Areas (~$500; no associated specification). 5. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 6. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 7. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 8. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 9. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
102	Inglewood Road over Brothers Creek	9/8/2022

Enter % in each condition. See BMIS User Manual 15.2.2

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk			100					R	Typical debris risk with evidence of logs being jammed in riprap.
2	Channel			75	25				R	Channel bends and constricts at the bridge, but not significantly.
3	Erosion Protection		50	50					R	Generally good-fair riprap work.
4	Substructure Scour		100						R	No evidence of scour except directly below storm sewer outfall on east embankment.
	SUBSTRUCTURE									
5	Foundation Movement		100						R	No evidence of foundation movement.
6	Abutments		100						R	Abutments in good condition.
7	Wing/Retaining Walls		25	50	25				R	Retaining walls in generally good condition but overly steep on southwest corner.
8	Embankment		50	35	15				R	Embankments generally good except for minor scour at east embankment.
9	Footings/Piling							N		
10	Pier Columns/Walls/Cribs							N		
11	Bearings			100					R	Only one face of bearings are exposed, but the integral abutments are fair.
12	Caps			100					R	Abutment cap is in fair condition.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		80	20						Girders are in generally good condition overall.
18	Portals							N		
19	Bracing/Diaphragms							N		
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets			80	20				1	Pipe hanger connections showing visible signs of pitting corrosion.
27	Camber/Sag			100					R	No camber issues.
28	Live Load Vibration			100					R	No live load vibration issues.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		60	20	20				R	Generally good-fair condition except for moderate deterioration at joint areas.
32	Deck Joints			75	25				R	Deck joints in fair-poor condition.
33	Curbs/Wheelguards			100					R	Curbs in generally fair condition.
34	Sidewalk(s)			90	10				R	Vegetation growth along parapet profile and typical light deterioration of joints.
35	Railings/Parapets			75	25				R	
36	Median Barrier						N			
37	Drains/Pipes			90	10				R	
38	Coating (Railings)			90	10				R	
	APPROACHES									
39	Signing/Lighting			50	50				R	
40	Roadway Approaches			100					R	
41	Roadway Flares				100				R	

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineators installed at all four corners. Fish-bearing creek signs on northwest and southeast bridge corners. Single File sign located at northwest corner of the bridge.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has moderate gradient at the bridge site.

Scour Notes

Insignificant scour on west embankment but east embankment has a scour pocket developing at the storm sewer outfall. Debris buildup is evident on both riprap slopes, but particularly on the east embankment, which could lead to future erosion.

Rehab Work Notes

Replace all pipe hanger components, which are heavily corroded. Resurface expansion joint pavement at both abutments. Reposition existing riprap or add additional riprap over the east embankment to prevent further scour and erosion below the storm sewer outlet pipe.

Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering the heavy bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge. Repair localized corrosion and damage to watermain casing.

Maintenance Work Notes

Remove vegetation from sidewalk and curb overhangs. Add delineator signs to all four corners of the bridge.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with localized deterioration to non-structural elements, including the pipe hangers and the deck wearing surface at the expansion joint locations. The box girders are in generally good condition, except for localized deterioration around the drain holes at each end. Vegetation, primarily in the form of moss, is widespread on the sidewalk and curb overhangs. There are no significant approach barriers or delineators; however, the straight alignment of the bridge helps mitigate that elevated crash risk. The storm sewer pipe outfall is causing localized erosion, which should be mitigated against soon. Potential solutions could include grouting together the rip rap directly below the pipe outfall to control the erosion and direct it toward the channel bottom, or alternatively, installing a slightly smaller diameter pipe within the existing pipe and extending it further toward the channel centreline, thus shifting the erosion concentration away from the abutment.

Additional Utility Concern Notes

Watermain hanger connections and hardware are significantly deteriorated.

Additional Urgency Rating Notes

The structure does not have significant vulnerability to gravity loads; however, the substructure configuration is expected to cause a poor seismic response. The non-structural repairs required on the bridge are not of high urgency.

Seismic Vulnerability Notes

The superstructure and abutment seats are robust and are unlikely to perform poorly in a seismic event; however, the cast-in-place columns supporting the abutment seat and ballast wall are likely vulnerable to seismic demands, particularly at the west abutment, where the columns are taller. The asymmetric column heights between the west and east abutment further complicate the expected seismic performance of the bridge.

Brook Robazza, Jesse Gallop
Inspector(s) (please type or print)


Signature(s)

Brook Robazza
Professional Engineer (EoR) (please type or print)


Signature(s)

STRUCTURE ID: 102 – INGLEWOOD ROAD OVER BROTHERS CREEK **DATE:** 09/08/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach
(Note Sidewalk along North Profile)

STRUCTURE ID: 102 – INGLEWOOD ROAD OVER BROTHERS CREEK **DATE:** 09/08/2022

GENERAL ARRANGEMENT

007. East Abutment (Note Storm Sewer Outfall)

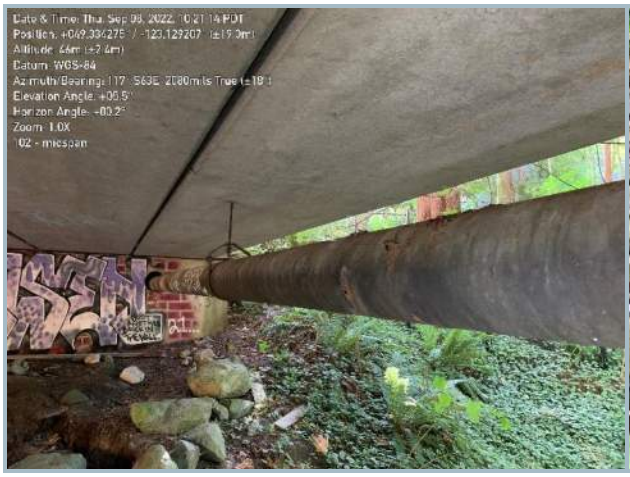
008. West Abutment

011. Bridge Deck

012. Bridge Soffit Viewed from South Profile

STRUCTURE ID: 102 – INGLEWOOD ROAD OVER BROTHERS CREEK **DATE:** 09/08/2022

CONFIGURATION



013. Watermain Utility along South Profile

014. Stormwater Outfall at East Abutment (Note Scouring)

015. Southeast Railing

016. Northwest Railing Transition

017. Manhole at Creek Bed (Note Debris in Creek Bed)

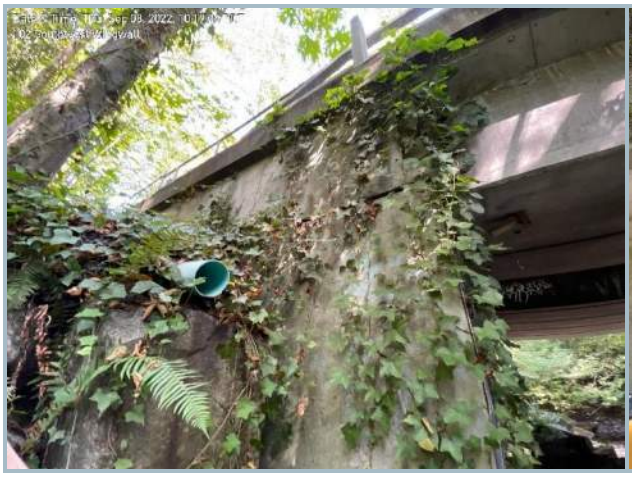
STRUCTURE ID: 102 – INGLEWOOD ROAD OVER BROTHERS CREEK **DATE:** 09/08/2022

SEISMIC FORCE REISISTING SYSTEM

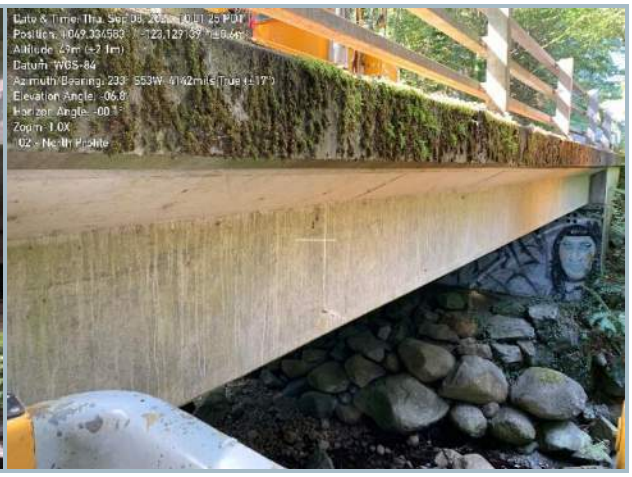
018. Northeast Integral Wingwall, Typ. (Note: Conduit Voids)

019. Elastomer Bearing at Abutment, Typ.

NOTABLE DEFICIENCIES



025. Drain



026. Vegetation Growth Along North Profile

027. Corroding Pipe Hanger Support, Typ.

028. Void around Watermain Utility at West Abutment (Note: Utility Pipe Directly bearing on Backwall)

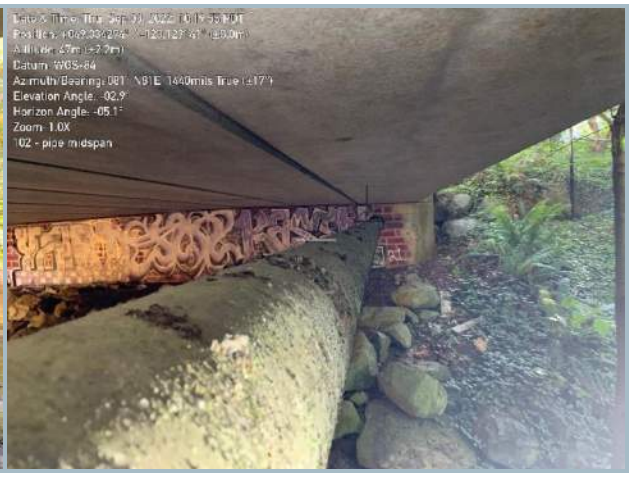
029. Cracking of Asphalt Wearing on East Approach Indicating Probable Settlement

030. Cracking of Asphalt Wearing on West Approach Indicating Probable Settlement

STRUCTURE ID: 102 – INGLEWOOD ROAD OVER BROTHERS CREEK **DATE:** 09/08/2022

NOTABLE DEFICIENCIES

031. Undermining at Northwest Section of West Abutment

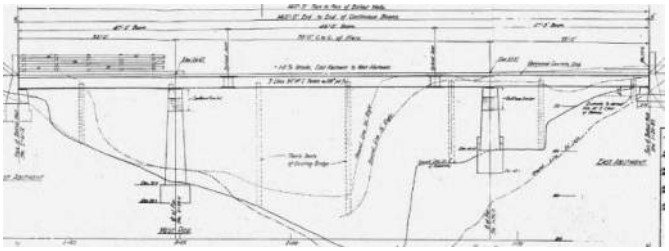


032. Vegetation Growth and Localized Corrosion of Watermain Utility

033. Notable Separation at Wingwall, Typ.

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

DESCRIPTION



CONSTRUCTION DATE:	1939	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Marine Drive	
FEATURE CROSSED:	Historical Goodson Creek Channel	
SUBSTRUCTURE:	Abutments - Spread Footing	
SUPERSTRUCTURE:	Continuous wide-flange steel girders	
WEARING SURFACE:	2-Lane, cast-in-place, non-composite, reinforced concrete deck	
APPROACHES:	Bridge is in straight-alignment with Marine Drive	
GENERAL:	SPANS:	3-span: 10.7m, 21.4m, 10.7m
	TOTAL LENGTH:	42.8m
	DECK AREA:	375m^2
	BEARINGS:	Steel
	BANK/PIER PROTECTION:	Rip rap bank stabilization at southeast corner
	GUARDRAIL:	Timber
	CURB:	Concrete
	UTILITIES	Watermain; Gas; Sanitary
	CLEARANCE:	12m
	ROADWAY CLASS:	Arterial
	SIGNAGE:	Chevron hazards (Direction of travel only), pedestrian
SEISMIC ASSESSMENT:	2006: Conceptual seismic assessment	
DIAGNOSTIC TESTING/STUDY:	2004: CSE testing, chain drag, chloride penetration tests	
PAST REHABILITATION WORKS:	1995: Cover plate caulking at west expansion joint 1998: Watermain was re-insulated 2004: Waterproofing membrane installed 2004: New expansion joint seals installed 2004: Seismic strengthening and upgrade 2006: RFP for Seismic Upgrade 2011: Abutment modifications and guardrail improvement and replacement 2012: RFP for Bridge Rehabilitation	

OVERALL CONDITION:	Fair Condition – Urgency Rating = 3
ESTIMATED REMAINING SERVICE LIFE:	20 yr (based on original major rehabilitation date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Approaches (~15 yr) 2. Recoat Girders and Steel Diaphragms (~20 yr) 3. Bearing Replacement (~20 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Perform Localized Girder Recoating and Spall Repairs (~$20,000) 2. Reinstall Road Barriers per Original Retrofit Design (~$25,000) 3. Repair Utility Line Protection (~$7,500) 4. Add TAC Barrier Flares or Crash Attenuators (~$5,000) 5. Add Delineator Signs and Bicyclist Dismount Signs (~$1,500)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$2,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
103	Marine Drive at Sandy Cove	9/8/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

INSPECTION NOTES BY COMPONENT
All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk	100							R	Dry historical creekbed.
2	Channel	100							R	Dry historical creekbed.
3	Erosion Protection		100						R	Adequate erosion protection for erosion potential.
4	Substructure Scour		100						R	No significant substructure scour.
	SUBSTRUCTURE									
5	Foundation Movement		100						R	No significant foundation movement.
6	Abutments			95	5				R	Previous repairs found at both abutments. Spalling and cracking at west abutment.
7	Wing/Retaining Walls			100					R	Heavily vegetated southeast retaining wall in generally fair condition at bridge.
8	Embankment			100					R	Embankments generally bedrock with light overburden above.
9	Footings/Piling			100					R	Footings poured directly on bedrock.
10	Pier Columns/Walls/Cribs			95	5				R	Generally fair condition except for isolated shear cracks. Past retrofits evident.
11	Bearings			20	80				R	Delamination and coating blistering due to advanced underfilm corrosion.
12	Caps			100					R	Bearing seat caps/shelves in generally good condition. Past retrofits evident.
13	Corbels			100					R	Corbels/hammerhead cantilevers in generally fair condition.
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms		50	50					R	End diaphragms zinc coated in a previous retrofit and in good-fair condition.
16	Stringers							N		
17	Girders		10	80	10				1	Top and bottom flange corrosion at multiple locations - prevalent at top flange.
18	Portals		30	65	5				R	Portal west pier in generally good-fair condition.
19	Bracing/Diaphragms		20	70	10				1	Channel bracing in generally good-fair condition with isolated corrosion.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals			75	25					Railing retrofits have vertical downstands that were not installed per design.
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		10	80	10					Numerous connection bolts have experienced light-moderate corrosion.
27	Camber/Sag			100						No significant superstructure camber issues.
28	Live Load Vibration			100						No significant live load vibration issues.
29	Coating (structure)		40	45	15					Consistent blooming (condensation exposure) of coating on rail guard.
	DECK									
30	Sub Deck/Cross Ties			95	5				2	Spalling and cracking with exposed reinforcing at spot locations along deck soffit.
31	Wearing Surface		35	60	5				1	Wearing surface generally good-fair except at joint locations.
32	Deck Joints			85	15				1	Portions of all joints have experienced moderate deterioration.
33	Curbs/Wheelguards			90	10				R	Curbs in generally fair condition except more poor at asphalt approach transitions.
34	Sidewalk(s)			90	10				R	Drain pipes do not appear to be obstructed. Narrow sidewalk with general wear.
35	Railings/Parapets			50	50				1	
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)			95	5				R	
	APPROACHES									
39	Signing/Lighting			75	25					
40	Roadway Approaches			50	50					
41	Roadway Flares				100					

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

3

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineators installed the southwest and northeast corners of the bridge. Gas Pipeline signs on the northeast corner of the bridge. Crosswalk signs above the west abutment of the bridge. Trail access sign on the northwest corner of the bridge.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

The drainage area appears to have been for the nearby Godman Creek, which may have been rerouted during the construction of this bridge. Currently there is minimal, if any, water flow beneath the bridge.

Scour Notes

Only light scour is present at the abutments and piers and is limited to small amounts of water runoff onto the embankments.

Rehab Work Notes

Perform localized girder recoating and spall repairs. Install anodes, if possible, to arrest ongoing corrosion of girder top flanges. Reinstall road barriers per 2011 design drawings. Repair pipe casing protection. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering the heavy bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Maintenance Work Notes

Clean deck drains, most of which are over 50% plugged. Install delineators on northwest and southeast corners of the bridge.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in fair condition, with minor structural deterioration that should be mitigated against to maintain the remaining service life of the structure. The areas of concern are widespread on the structure, but are generally limited to localized deck soffit spalling, coating failure, and girder top flange corrosion. The road barriers installed during the 2011 retrofit do not appear to have been installed as intended, and while their out-of-plane capacity is likely to be near-design, vertical and longitudinal forces are significantly diminished due to the current configuration (there are two missing bolts at the bottom of the barrier anchorage connection, possibly due to a geometry conflict).

Additional Utility Concern Notes

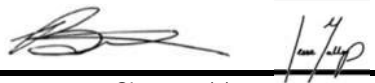
Minor localized deterioration of the watermain, particularly over the pier locations.

Additional Urgency Rating Notes

The seismic vulnerability of the structure is expected to be low due to the presence of previous seismic retrofits, but the road barrier capacity is important to note. Typical localized deck soffit spalling, girder top flange corrosion, and coating failures need to be addressed as well, though not at immediate urgency.

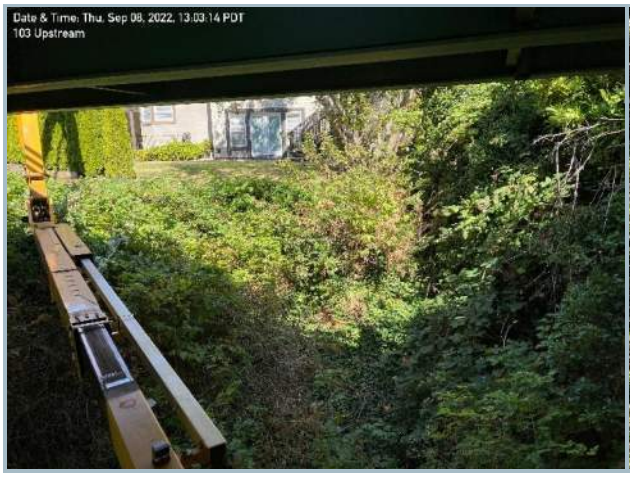
Seismic Vulnerability Notes

The previous seismic retrofits from 2006 appear robust, but may require modification to meet current code seismic hazard levels. The multi-span structure, in it's unretrofitted state would have significant seismic vulnerabilities present, but the previous retrofits largely address most of the original seismic vulnerabilities.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

GENERAL ARRANGEMENT



001. Upstream

002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. West Pier Abutment

010. East Pier Abutment

011. Bridge Deck

012. Bridge Soffit

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

CONFIGURATION

013. South Railing Detail, Typ.

014. Utility Along South Profile

015. Sanitary Utility along North Profile
(Note: Park Entrance at Northwest Section)

016. Sanitary Utility Connection at East Abutment

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

SEISMIC FORCE REISISTING SYSTEM

017. Intermediate and Pier Lateral Restraint (As part of Shear Key Retrofit)

018. Anchored Steel Bearing Plate, Typ.

019. Longitudinal Anchor Restraint System at East Pier

020. Longitudinal Diagonal Restraint System at East Pier, Typ.

021. Lateral Bracing at West Pier

022. Reinforced East Pier Base

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

NOTABLE DEFICIENCIES

023. Corrosion-led Delamination of Steel Bearing Plate, Typ.

024. Concrete Delamination & Cracking Adjacent to Pipe Connection at West Abutment
(Note: Bolted Lateral Restraint Connection)

025. Bottom Flange Surface Corrosion and Deposit Attack at Abutment, Typ.

026. Spalling above East Pier Brace

027. Railing Support Connection Bolts Missing Along South Profile, Typ. (Note Continuous Top Flange Corrosion, Typ.)

028. Railing Support Connection Bolts Missing Along South Profile, Typ.

STRUCTURE ID: 103 – MARINE DRIVE AT SANDY COVE **DATE:** 09/08/2022

NOTABLE DEFICIENCIES

029. Corroding Drainpipe Outlets

030. Exposed Reinforcing on Concrete Soffit (Note Localized Deterioration of Pipe Surface

031. Exposed Reinforcing on Concrete Soffit at Midspan along Second Girder from South Profile (Note: Efflorescence and Cracking around Previous Deck Drain)

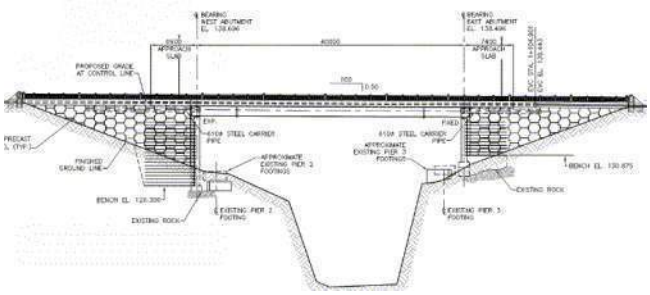
032. Localized Corrosion-led Deterioration of Bottom Flange at West Pier, Typ.

033. Exposed Reinforcing on Concrete Soffit at Midspan along South Profile

034. Cracking of Backwall around Sanitary Utility and Concrete Repair at West Abutment

STRUCTURE ID: 104 – ALMONDEL ROAD OVER CYPRESS CREEK **DATE:** 09/08/2022

DESCRIPTION



CONSTRUCTION DATE:	2008	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Almondel Road	
FEATURE CROSSED:	Cypress Creek	
SUBSTRUCTURE:	Abutments – semi-integral reinforced concrete abutments on bedrock with MSE retaining walls	
SUPERSTRUCTURE:	Welded steel plate girders with cast-in-place composite concrete deck	
WEARING SURFACE:	Asphalt, 2-Lane composite concrete deck	
APPROACHES:	Approaches are curved onto the straight-aligned bridge	
GENERAL:	SPANS:	1-span: 40.0m
	TOTAL LENGTH:	41.4m
	DECK AREA:	448m^2
	BEARINGS:	Elastomeric
	BANK/PIER PROTECTION:	Bedrock-walled canyon
	GUARDRAIL:	Steel on concrete upstand
	CURB:	Concrete
	UTILITIES	Gas; Watermain; Telecommunication line
	CLEARANCE:	23m
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Fish-bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 1
ESTIMATED REMAINING SERVICE LIFE:	61 yr
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~10 yr) 2. Recoat Girders near Abutment (~16 yr) 3. Bearing Replacement (~16 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Repair (2) Railing Balusters on Northwest Bridge Approach (~$1,500) 2. Perform Localized Railing Recoating (~$1,500)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Drain Holes, Sidewalk, and Gutters (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
104	Almondel Road over Cypress Creek	9/8/2022

COMPONENT | **PERCENT CONDITION RATING** Enter % in each condition. See BMIS User Manual 15.2.2 | **INSPECTION NOTES BY COMPONENT** All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

		E	G	F	P	V	X	N	CU	
	HYDROTECHNICAL									
1	Debris Risk		100						R	High clearance above Cypress Creek.
2	Channel		100						R	High clearance above Cypress Creek.
3	Erosion Protection		75	25					R	Erosion protection required at East abutment but bedrock foundations.
4	Substructure Scour		100						R	No evidence of scour.
	SUBSTRUCTURE									
5	Foundation Movement		100						R	No evidence of foundation movement.
6	Abutments		100						R	Staining of abutment wall behind pipe connection indicating water egress.
7	Wing/Retaining Walls		50	50					R	Minor separation along some retaining wall joints.
8	Embankment		75	25					R	East embankment has some loose soil vulnerable to erosion. West abutment good.
9	Footings/Piling		95	5					R	Footings in generally good condition.
10	Pier Columns/Walls/Cribs							N		
11	Bearings		100						R	Minor bearing bulging, minor delaminaton visibile on west abutment bearings.
12	Caps		100						R	Pile caps at abutments in good condition.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		75	20	5				R	Minor pitting corrosion and patina delamination visible on top flange segments.
18	Portals							N		
19	Bracing/Diaphragms			100					R	Construction cross-bracing in generally fair condition.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		50	50					R	Surface corrosion visible on anchor bolts with minimal signs of corrosion fatigue.
27	Camber/Sag		100						R	No camber issues.
28	Live Load Vibration		100						R	No live load vibration issues.
29	Coating (structure)			80	20				2	Signs of coating failure visible near abutments with blistering and delamination.
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		75	25					R	Wearing surface in generally good-fair condition.
32	Deck Joints			70	30				2	Efflorscence at parapet visible from deck soffit. Joint seals failing.
33	Curbs/Wheelguards		50	50					R	Curbs are generally good-fair condition.
34	Sidewalk(s)		50	50					R	Downpipes along north deck edge are suffering significant lamellar corrosion.
35	Railings/Parapets		80	20					R	
36	Median Barrier							N		
37	Drains/Pipes		80	20					R	
38	Coating (Railings)		85	10	5				R	
	APPROACHES									
39	Signing/Lighting		80	20						
40	Roadway Approaches			100						
41	Roadway Flares				100					

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

1

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineators installed at all four corners. Fish-bearing creek signs on northwest and southeast bridge corners.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Black, Cypress, and Hollyburn Mountains, with sections of steep gradient, but the creek is low gradient at the bridge location.

Scour Notes

The bridge significantly overspans the creek and is set back from canyon rock walls. A small amount of erosion action was identified on the east embankment, but it was not significant at the time of the inspection.

Rehab Work Notes

Repair two damaged railing balusters and retouch paint across full-length of railings as-needed.

Maintenance Work Notes

Add delineator and bicycle dismount signs. Monitor deck joints in asphalt for further deterioration. Monitor the girders for further corrosion.

Monitor east embankment in front of the east abutment for potential future erosion action.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with no major areas of concern. The girders have experienced above-average corrosion for weathering steel for this age of structure, though it is common for weathering steel to fair poorer in environments close to the ocean.

Additional Utility Concern Notes

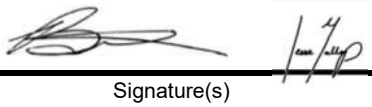
Watermain and gas pipeline supports are in generally good condition.

Additional Urgency Rating Notes

Overall no urgency on any repair items of this structure.

Seismic Vulnerability Notes

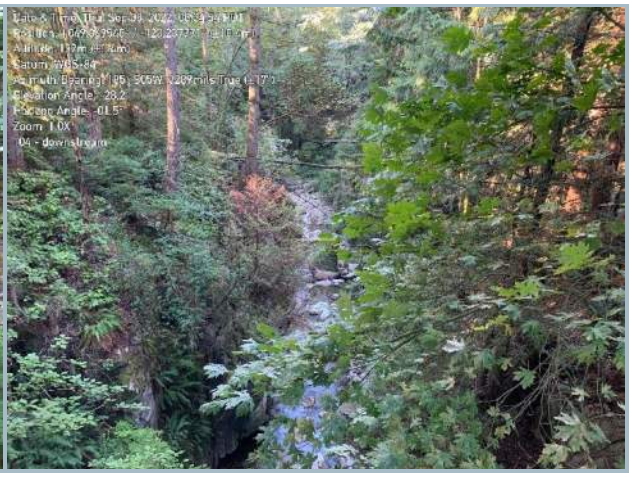
The structure is relatively new and has a seismic force-resisting system that is considered robust. Tall retaining walls on the south perimeters of the approaches

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 104 – ALMONDEL ROAD OVER CYPRESS CREEK **DATE:** 09/08/2022

GENERAL ARRANGEMENT

001. Upstream



002. Downstream

003. North Elevation

004. South Elevation

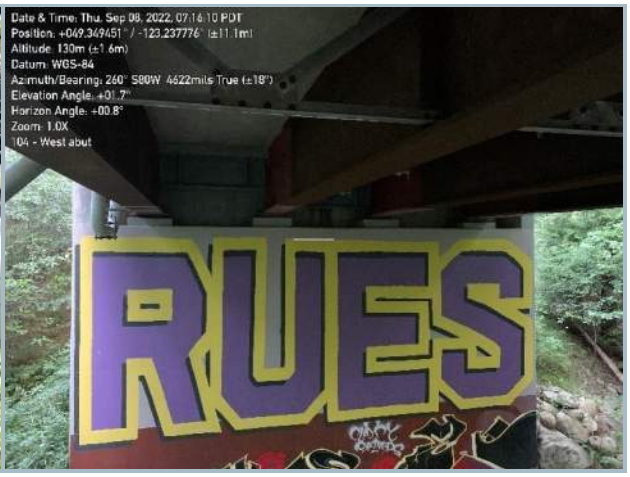
005. East Approach

006. West Approach (Note Skewed Orientation)

STRUCTURE ID: 104 – ALMONDEL ROAD OVER CYPRESS CREEK **DATE:** 09/08/2022

GENERAL ARRANGEMENT

007. East Abutment



008. West Abutment

009. Bridge Deck

010. Bridge Soffit

STRUCTURE ID: 104 – ALMONDEL ROAD OVER CYPRESS CREEK **DATE:** 09/08/2022

CONFIGURATION

011. Central Waterman Utility (Note Staining of Backwall)

012. MSE Retaining Wall Along Southeast Section, Typ.

013. Retaining Wall Separation (Note Utility Line Along South Profile)

014. Abutment Footing Extension at East Abutment, Typ.

015. Northwest Corner Railing Transition (Note continuous Approach Slab Joint)

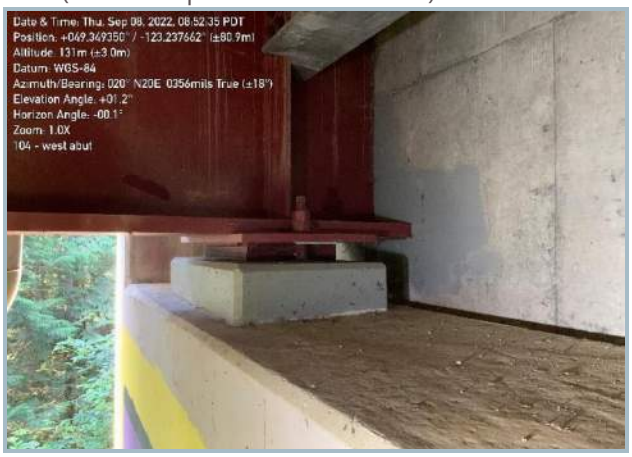
016. Change of Girder Coating Near Abutments, Typ.

STRUCTURE ID: 104 – ALMONDEL ROAD OVER CYPRESS CREEK **DATE:** 09/08/2022

SEISIMIC FORCE REISISTING SYSTEM

017. Lateral Bracing at Midspan, Typ. (Note Composite Concrete Deck)

018. Abutment Lateral Restraint, Typ.



019. Anchored Elastomeric Bearing at Abutment, Typ.

STRUCTURE ID: 104 – ALMONDEL ROAD OVER CYPRESS CREEK **DATE:** 09/08/2022

NOTABLE DEFICIENCIES

013. Corroding Weeping Drain Outlet, Typ.

014. Localized Mill Scale Flaking on Bottom Flange of Weathering Steel (Expected Behavior)

015. Low-level Utility Line Crossing East Abutment

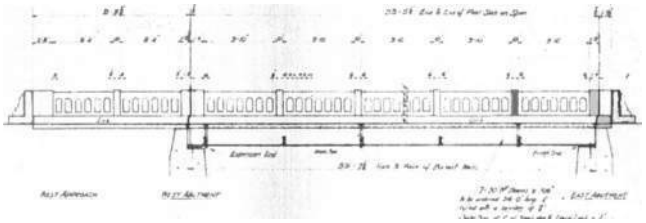
016. Narrow Hydraulic Channel Guided by Steep Riverbanks

017. Minor Discolouration in Rail Coating

018. Dislodged Picket at Northwest Section

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	1940 (Pedestrian bridge 1977)	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Marine Drive	
FEATURE CROSSED:	Cypress Creek	
SUBSTRUCTURE:	Abutments: - Spread Footings	
SUPERSTRUCTURE:	Steel girders with non-composite cast-in-place concrete deck; pedestrian bridge is a steel space truss	
WEARING SURFACE:	2-Lane asphalt surface; adjacent pedestrian bridge has checker plate steel walkway	
APPROACHES:	Bridge is in straight-alignment with Marine Drive and crests towards mid-span	
GENERAL:	SPANS:	1-span; 17.0m
	TOTAL LENGTH:	17.0m
	DECK AREA:	164m^2
	BEARINGS:	Steel
	BANK/PIER PROTECTION:	Riprap and bedrock
	GUARDRAIL:	Concrete
	CURB:	Concrete
	UTILITIES	Gas; Watermain
	CLEARANCE:	3m
	ROADWAY CLASS:	Arterial
	SIGNAGE:	Delineators; School Zone; Fish-bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	1997: Pedestrian bridge recoated 2003, 2006: Chain drag survey during principal inspections 2005: Chloride penetration survey, chain drag and rebar depth survey 2005: Load & Deck Testing	
PAST REHABILITATION WORKS:	1998: Girder strengthening – addition of plates to bottom flanges 2005: New asphalt wearing surface and waterproofing membrane installed	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	10 yr (based on original major rehabilitation date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Approaches (~10 yr) 2. Recoat Girders and Steel Diaphragms (~10 yr) 3. Bearing Replacement (~10 yr) 4. Strengthen Utility Connections (~10 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Inject and Seal Abutment, Wing Wall, Parapets Joints/Cracks (~$4,000) 2. Install Riprap at Southeast Footing Corner (~$2,500) 3. Perform Localized Girder and Pipe Frame Recoating and Spall Repairs (~$15,000) 4. Add Bicyclist Dismount Signs on Sidewalks (~$1,000) 5. Add TAC Barrier Flares or Crash Attenuators (~$5,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 6. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 7. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
105	Marine Drive over Cypress Creek	9/5/2022

	COMPONENT	PERCENT CONDITION RATING (Enter % in each condition. See BMIS User Manual 15.2.2) E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT (All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.)
	HYDROTECHNICAL									
1	Debris Risk			80	20				R	Modestly elevated debris risk due to abutments crowding creek channel.
2	Channel		100						R	Skewed to match channel.
3	Erosion Protection		50	50					3	East Abutment Fair, West Abutment Good.
4	Substructure Scour		65	20	15				3	South portion of east abutment scoured to 600mm below top of footing.
	SUBSTRUCTURE									
5	Foundation Movement			65	35				R	Evidence of minor settlement due to cracking in the stem wall of both abutments.
6	Abutments			80	20				3	Generally fair condition except for intermittent settlement cracks.
7	Wing/Retaining Walls			80	20				3	Wing walls show signs of settlement cracks.
8	Embankment		100						R	Embankments are well-protected.
9	Footings/Piling			90	10				R	No issues with exposed footings except for intermittent settlement cracks.
10	Pier Columns/Walls/Cribs			60	40				3	Ballast walls behind girders have experienced moderate cracking.
11	Bearings			70	30				2	Girders directly bear on bearings seats, but generally performing well.
12	Caps			60	40				3	Bearing seats in fair-poor condition.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		10	80	10				3	Localized locations of exposed soffit reinforcing and top flange corrosion.
18	Portals							N		
19	Bracing/Diaphragms		10	80	10				3	Generally fair except for minor erosion at connections.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		10	80	10				1	Generally fair except for localized corrosion.
27	Camber/Sag		100						R	No sag issues.
28	Live Load Vibration		100						R	No LL vibration issues.
29	Coating (structure)		70	20	10				2	Generally good except around top flange.
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		70	20	10				R	Generally good except at expansion joints and approach slab joints.
32	Deck Joints		25	35	5	10			4	Expansion joint sealing in several places, especially on parapets.
33	Curbs/Wheelguards		50	50					R	Generally good except for deteriorated ramp curb at southwest corner.
34	Sidewalk(s)		50	30	20				1	Generally good except for transitions to sidewalk along the north deck edge.
35	Railings/Parapets		20	60	20				3	
36	Median Barrier							N		
37	Drains/Pipes		20	60	20				1	
38	Coating (Railings)		30	40	30				2	
	APPROACHES									
39	Signing/Lighting		10	80	10				R	
40	Roadway Approaches		40	60					R	
41	Roadway Flares		50	50					R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineator signs present on all four corners of the bridge. Fish-bearing creek sign on northeast corner. School zone sign on southwest corner.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Black, Cypress, and Hollyburn Mountains, with sections of steep gradient, but the creek is low gradient at the bridge location.

Scour Notes

Scour was present along both abutments, but was significantly more pronouced at the southeast corner.

Rehab Work Notes

Inject and seal abutment, wing wall, parapets joints and cracks. Install riprap at southeast bridge corner where scour is affecting the east foundation. Perform localized girder recoating and spall repairs, particularly along north deck edge. Install anodes, if possible, to arrest ongoing corrosion of girder top flanges. Replace expansion joint seals in parapets. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering the heavy bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Maintenance Work Notes

Provide permanent repair to watermain, which has been retrofitted in a temporary manner. Repair water main lining that been damaged. Clean connections of sidewalk support truss.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

1030mm-high parapet

940mm-high railing

Overall the structure is in relativelly good-fair condition, with recent upgrades and repairs evident. Further minor repairs are required to ensure the adequate performance or the structure, as well as its long-term longevity.

Additional Utility Concern Notes

Utility pipe along south profile has deteriorated casing with a small section removed at midspan. Utility pipe connection is wrapped at reduced section segment along south profile. Signs of visibile deteriation of redudant utility support along north profile.

Additional Urgency Rating Notes

While the structure is likely vulnerable to seismic loading, gravity load-carrying capacity is not signficantly reduced. Moderate urgency of repairs are required to reduce further deterioration of the deck soffit and edges, as well as corrosion of the top flanges of the girders.

Due to the lack of seismic force-resisting system, the structure is considerd to be moderately vulernable to seismic forces.

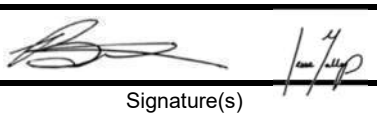
Seismic Vulnerability Notes

There is no robust seismic force-resisting system at the abutments to reliably transfer superstructure seismic demands to the foundation.

The structure is relatively small and is only a single-span bridge, and therefore seismic demands are not expected to be excessive.

Brook Robazza, Jesse Gallop

Inspector(s) (please type or print)



Signature(s)

Brook Robazza

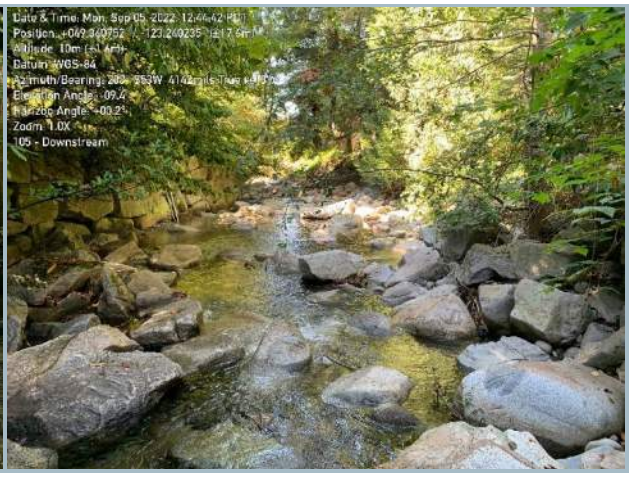
Professional Engineer (EoR) (please type or print)

Signature(s)

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. Upstream



002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. Bridge Deck

010. Bridge Soffit

011. North Walkway Soffit
(Note Gas Utility Pipe)

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

CONFIGURATION

012. South Parapet and Sidewalk

013. North Parapet and Pedestrian Walkway

014. North Walkway Transition

015. North Parapet Joint

016. Stringer Welded Strengthening Plate at Midspan Sections, Typ.

017. Watermain Utility Along South Profile (Note: Deterioration of Pipe Surface at Midspan)

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

CONFIGURATION

018. Gas Pipeline Support, Typ.

019. Gas Utility Pipe Diameter Transition at North Profile

SEISMIC FORCE REISISTING SYSTEM

020. Anchored Steel Bearing Plate, Typ. (Note Surface Corrosion)

021. Lateral Bracing Elements at Equivalent Spacing, Typ.

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES

022. Cracking in Asphalt Wearing Surface of West Approach Slab

023. Efflorescence and Cracking Northwest Section of Parapet

024. Exposed Section of Reinforcing at North Profile, Typ.

025. Efflorescence and Cracking at Southeast Wingwall

026. Longitudinal Cold-joint Separation at East Abutment Front Wall

027. Efflorescence and Cracking at East Abutment Back Wall, Typ.

STRUCTURE ID: 105 – MARINE DRIVE OVER CYPRESS CREEK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES

028. Top Flange Corrosion and Concrete Delamination at Soffit, Typ.

029. Localized Exposed Reinforcing at Soffit, Typ. (Note: Concrete Delamination at Northeast Section of East Abutment)

030. Continuous Top Flange Corrosion of North Stringer, Typ.

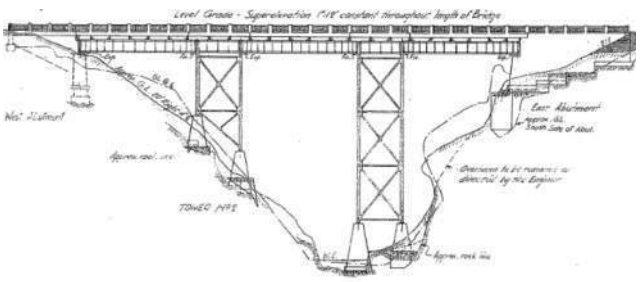
031. Bent Truss Strut Element and Corroding Walkway Soffit, Typ.

032. Cracking at Northwest Wingwall Section

033. Wingwall Cracking at Southwest Side Wall

STRUCTURE ID: 106 – NELSON CANYON OVER NELSON CREEK **DATE:** 10/05/2022

DESCRIPTION



CONSTRUCTION DATE:	1956	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Marine Drive	
FEATURE CROSSED:	Cypress Creek	
SUBSTRUCTURE:	Abutments - Spread Footings on bedrock Pier Towers – Concrete pedestals on bedrock	
SUPERSTRUCTURE:	Riveted steel plate girders & floor beams, with lateral bracing and composite concrete	
WEARING SURFACE:	Concrete	
APPROACHES:	Bridge is superelevated and curved on an old alignment of Hwy 1	
GENERAL:	SPANS:	3-span: 12.9m, 24.3m, 21.9m
	TOTAL LENGTH:	68.0m
	DECK AREA:	656m^2
	BEARINGS:	Steel
	BANK/PIER PROTECTION:	Spill through abutments
	GUARDRAIL:	Concrete/steel
	CURB:	Concrete
	UTILITIES	Watermain (on bridge deck)
	CLEARANCE:	30m to girder soffit
	ROADWAY CLASS:	Closed to vehicle traffic
	SIGNAGE:	None
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	2017: Lifecycle Study 2019: Bridge Feasibility Study 2021: Load Rating for Film 2022: All-Span Bridge Assessment	
PAST REHABILITATION WORKS:	2016: Delaminated Concrete Removal 2018: RFP for Design-Build: Demolition & Replacement	

OVERALL CONDITION:	Poor-Fair Condition – Urgency Rating = 4
ESTIMATED REMAINING SERVICE LIFE:	9 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Potential Concrete Deck Removal and Replacement with Lighter Structure (<5 yr) 2. Potential Rehabilitate and Recoat Highly-Corroded Elements (<5 yr) 3. Potential Retrofit of Select Bridge Components (<5 yr) 4. Potential Replacement of Bridge (<5 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Load Rating Analysis Study (~$30,000) 2. Seismic Assessment Study (~$125,000) 3. Retrofit Options Study (~$125,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 2 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Gutters (~$1,000; no associated specification). 3. Clean Vegetation from Deck Overhangs (~$2,000; no associated specification). 4. Reseal Deck Joints ($2,000; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 413.32.06b) 5. Clean Debris from Bearing Areas and Horizontal Non-Free-Draining Members (~$6,000; no associated specification). 6. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 7. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 8. Remove Debris from Channel Under Bridge (~$1,500; no associated specification).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	106	Structure Name	Nelson Canyon over Nelson Creek	Inspection Date (yyyy/mm/dd)	10/5/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk			100					R	East pier pedestals are directly in hydraulic channel causing moderate debris accumulation.
2	Channel			70	30				R	Steep embankments founded on bedrock outcrops with loose topsoil. Skewed channel upstream obstructed by riprap and east pier. Bed levels appear stable.
3	Erosion Protection		50	50					R	Isolated areas of bank erosion.
4	Substructure Scour			100					R	Scour in between east pier pedestals has formed a pool approximately 1m deep at low flows.
	SUBSTRUCTURE									
5	Foundation Movement		70	30					R	Crack in concrete at southeast backwall of east abutment indicates minor settlement of abutment towards southwest direction.
6	Abutments		60	40					3	Light to medium scaling; medium sized cracks with prevalent hairline cracks.
7	Wing/Retaining Walls			50	30	20			2	Widespread efflorescence and cracking (medium to wide) at East abutment wing walls and West abutment. Exposed reinforcing and concrete void at West abutment side wall.
8	Embankment			50	50				R	Some undermining of footings due to erosion. Erosion contributing to exposure of bottoms of footings at west pier and abutment.
9	Footings/Piling			20	80				2	Widespread efflorescence and prevalent cracking of concrete pedestals and footings. Exposed reinforcing at west abutment.
10	Pier Columns/Walls/Cribs			70	20	10			4	Light corrosion with no noticable section loss on most elements. Localized section loss at northwest column base of West pier. Debris accumulation in pier column bracing.
11	Bearings			40	60				3	Medium or heavy corrosion of the exposed steel surfaces.
12	Caps			50	50				3	Exposed reinforcing at west abutment jump span cap beam.
13	Corbels			40	60				3	Widespread efflorescence, cracking, and exposed reinforcing at west abutment corbels.
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms			20	40	30	10		4	Floor beam sections along south profile at expansion joint locatins have heavy corrosion with occasional full-section loss pockets. Uniform corrosion are persistent on top and bottom flanges.
16	Stringers							N		
17	Girders			50	40	10			4	South girder has sections of heavy corrosion with significant delamination of top and bottom flanges.
18	Portals							N		
19	Bracing/Diaphragms			70	20	10			1	Diaphragms have light corrosion but in good condition overall. Knee braces for floor beams have have heavy corrosion with complete section loss at two locations along south profile.
20	Truss Chords/Arch Ribs			80	20				1	Moderate corrosion on most pier truss components, but significant for horizontal members.
21	Arch Ties							N		
22	Truss Diagonals			80	20				1	Light to medium corrosion of pier truss components.
23	Truss Rods/ Verticals			80	20				1	Light to medium corrosion of pier truss components.
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets			35	50	15			4	Complete section loss of some rivets due to corrosion along top flange sections.
27	Camber/Sag			100						No significant superstructure camber issues.
28	Live Load Vibration			100						No significant live load vibration issues, although no active traffic crossing during inspection.
29	Coating (structure)			60	40					Advanced deterioration at several locations specfically along south profile floorbeams..
	DECK									
30	Sub Deck/Cross Ties			40	40	20		N	3	Spalling, cracking with exposed reinforcing at spot locations along deck soffit including large section of exposed reinforcing at midspan.
31	Wearing Surface			80	20				1	Minor cracking at localized areas on bridge deck. Wearing surface is in good condition overall.
32	Deck Joints		20	80					2	Cracking and spalling around deck joints. Incidences of joint misalignment.
33	Curbs/Wheelguards			80	20				2	Spalling and exposed reinforcing at localized sections of curb adjacent to deck drain locations on south profile.
34	Sidewalk(s)							N		
35	Railings/Parapets			80	20				1	
36	Median Barrier		80	20					R	
37	Drains/Pipes			100					R	
38	Coating (Railings)			50	50				R	
	APPROACHES									
39	Signing/Lighting							N		
40	Roadway Approaches			100						
41	Roadway Flares			100						

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

4

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

No signage at time of inspection (note that the inspection timing coincided with the filming of a TV show, so on-deck fencing and other signage may have been removed).

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Black Mountain, with sections of steep gradient, but the creek has low to moderate gradient at the bridge site.

Scour Notes

There is moderate scour evident in between the east pier pedestals, where a 1m scour hole has developed. The scour does not appear to be affecting the current bridge performance or functionality.

Rehab Work Notes

Due to the lifeline nature of the bridge (carries a watermain) and it's reduce functionality from it's original design, extensive rehabilitation may be required. This is likely best carried out following a special study to investigate the adequacy of the existing structure. During the inspection, it was identified that both the gravity and seismic load-carrying systems could be relieved of significant demands by removing the existing concrete deck (accounting for ~85% of the gravity and seismic mass) and replacing it with an economical partial-width timber deck that could accommodate both the watermain and pedestrian and maintenance vehicle traffic. The special study could be discretized into three separate studies: a load rating analysis; a seismic assessment; and a retrofit options study. Aside from potentially removing the concrete deck, other rehabilitation items that likely need to be addressed are the floorbeams under the expansion joints, the horizontal members of the pier trusses, and the connections from the pier legs to the spread footing pier pedestals.

Maintenance Work Notes

Clean gutters, deck surface, and deck overhangs of vegetation and general forest debris. Reseal deck joints across entire deck, with particular focus at floor beam expansion joint locations. Clean debris from bearing areas and horizontal pier truss members that are not free to drain water effectively. Remove any debris build-up around east pier legs.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Note that the inspection timing coincided with the filming of a TV show, which is evident in some of the photosheet photos. Overall, the bridge is in fair-poor condition, with the primary members of concern being the expansion joint floor beams and the horizontal members of the pier trusses. Local deterioration is prevalent at both abutments, in a manner that suggests that the articulation of the bridge is not functioning as intended, with horizontal cracking at the east abutment back wall indicating that deck is imparting large demands to its top. All of the expansion joints on the bridge are in poor condition, and appear to have led to the extensive corrosion of the underlying floorbeams. Floorbeams not under the expansion joints make up the majority of these members and they are in much better condition, except occasionally at the abandoned watermain connections along the south profile of the bridge. The south profile girder's top flanges have also experienced significant corrosion in the vicinity of the expansion joints. The truss pier members are in generally good-fair condition, except for where water was not free to drain due to debris accumulation. It is recommended that detailed inspections be carried out for all future load rating analyses to ensure the observed deterioration is adequately taken into account.

Additional Utility Concern Notes

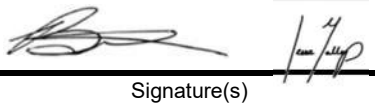
The watermain on the deck is loosely supported on aging timber blocks. These appear to have shifted over time due to thermal expansion and contraction. As a result, the connections may be under stress; however, due to the extra length provided on the bridge deck, there is likely enough spatial freedom to maintain the flexibility required. The watermain does appear to be uninsulated, which may pose a risk during cold-weather events.

Additional Urgency Rating Notes

The structure is a lifeline structure due to the presence of the watermain on the deck and therefore it is important that this bridge does not become damaged to a degree that could interupt the watermain's function. The complexity, age, and local deterioration of the bridge elevates it's risk beyond a typical pedestrian-only bridge. Currently the load carrying capacity of the bridge is unknown, aside from some limited load rating analyses conducted for specific filming purposes. Typical pedestrian traffic is likely not going to overload the bridge in its current condition.

Seismic Vulnerability Notes

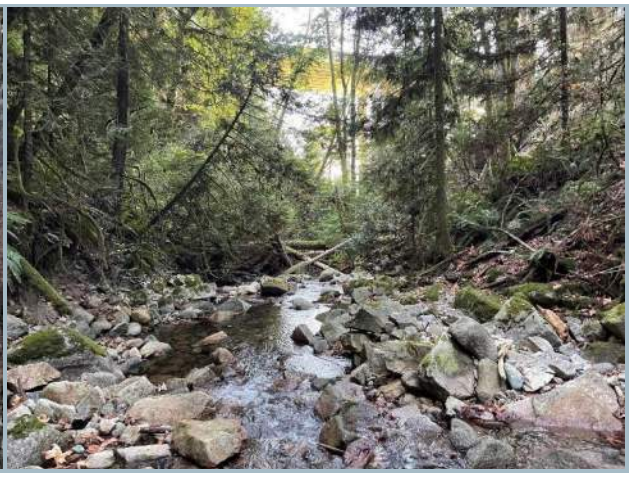
This complex structure was designed during a period when seismic demands were not well understood or necessarily directly accounted for, and this is evident in the detailing of the structure. There is no clear or robust seismic force-resisting structure currently in-place, and therefore the structure is expected to perform poorly during seismic loading. Potential retrofit options include removing the concrete deck to reduce seismic demands on the substructure and installing rocking foundations at the pier pedestal connections to further reduce demands to the foundations.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 106 – NELSON CANYON OVER NELSON CREEK **DATE:** 10/05/2022

GENERAL ARRANGEMENT

001. Upstream



002. Downstream

003. North Elevation

004. South Elevation (Note Existing Utility Pipe)

005. East Approach

006. West Approach

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. West Pier Abutment

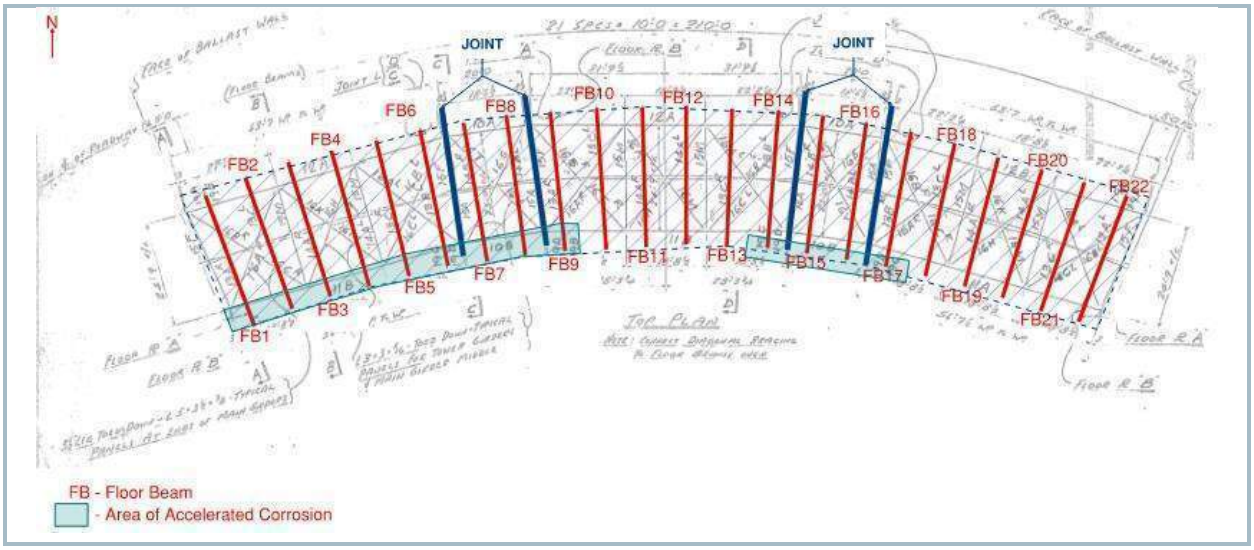
010. East Pier Abutment

011. Bridge Deck Viewing West

012. Bridge Soffit

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

GENERAL ARRANGEMENT



013. General Arrangement of Floor Beams

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

CONFIGURATION

014. Northeast Pier Pedestal at West End

015. Northwest Pier Pedestals at East End

016. Southeast Pier Pedestal at West End

017. Jump Span Cap Beam at West Abutment

018. Girder Connection to Accommodate Bridge Skew, Typ.

019. Pier Lateral Bracing Gusset Plate Connection, Typ.

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

CONFIGURATION

020. Northeast Pier Pedestal at West End

021. Northwest Pier Pedestals at East End

022. Pier Midspan Gusset Plate Connection, Typ.

023. Pier Corner Connection, Typ.

024. Plate Girder Lateral Bracing Connection

025. Pier Cross-bracing Connection, Typ.

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

CONFIGURATION

026. South Profile Parapet

027. Expansion Joint Plate Detail, Typ.

028. Utility Power Line Viewing from East Abutment

029. Stormwater Outfall at North Section of East

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

SEISMIC FORCE REISISTING SYSTEM

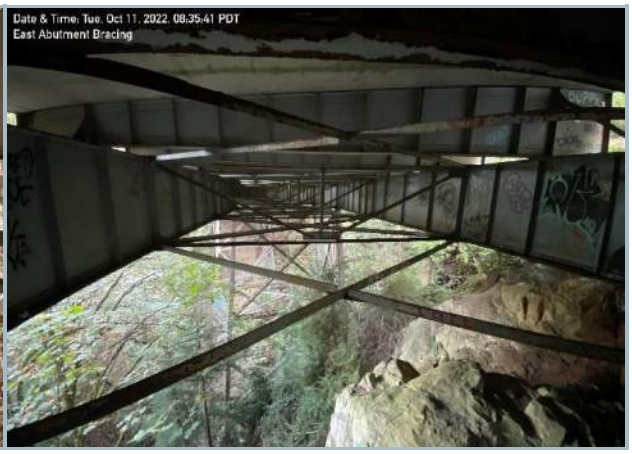
030. Anchored Bearing Plate Connection

031. Alternating Knee Bracing along South

032. Alternating Longitudinal Bracing Along North Profile, Typ.

033. Alternating Lateral Bracing, Typ.

034. Vertical Bracing over Pier Section, Typ.



035. Horizontal Cross-Bracing and Intermediate Vertical Lateral Bracing Elements, Typ.

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

NOTABLE DEFICIENCIES

036. Pitting Corrosion with ~3mm Section Loss at Bottom of Northeast Pier

037. Deposit Attack and Accumulation on Bottom Flange of South Girder, Typ. (Note: Deterioration of Rivets)

038. Accelerated Uniform Corrosion at Bottom Flange of Floor Beam 5

039. 3-5mm Section Loss on Bottom Flange of Floor Beam 9 (Note: Top Flange Corrosion, Typ.)

040. Accelerated Uniform Corrosion on Top Flange of Floor Beam 5, Typ.

041. 3-5 Section Loss at Bottom Flange of Floor Beam 5 Below Expansion Joint

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

NOTABLE DEFICIENCIES

042. Complete Section Loss at Floor Beam 7

043. Steel Delamination and Deposit Accumulation at South Girder, Typ.

044. Accelerated Uniform Corrosion at Bottom Flange of Floor Beam 6

045. 3-5mm Section Loss at Bottom Flange of Floor Beam 6

046. Top Flange Corrosion and Spalling of Deck Soffit at Floor Beam 14

047. Exposed Reinforcing Section of Deck Soffit at Floor Beam 15

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

NOTABLE DEFICIENCIES

048. South Girder Bottom Flange Corrosion, Typ.

049. Accelerated Corrosion and Deposit Attack on Floor Beam 2

050. 4mm Section Loss at Northwest Base of West Pier

051. Debris Accumulation at Pier Northwest Column Base of East Pier

052. Vegetation Growth on East Pier Connection, Typ.

053. Debris Accumulation on Pier Truss Elements of East Pier

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

NOTABLE DEFICIENCIES

054. Concrete Void at West Abutment South Side Wall

055. Exposed Reinforcing at South Wall of East Abutment

056. Exposed Reinforcing at South Section of West Abutment Side Wall

057. Concrete Spall and Exposed Reinforcing at Midspan of South Girder Profile

058. Localized Sections of Exposed Reinforcing at Midspan Along South Profile, Typ.

059. Extensive Efflorescence at Southeast Pedestal of West Pier

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

NOTABLE DEFICIENCIES

060. Efflorescence on Deck Soffit of West Abutment

061. Extensive Efflorescence at East Abutment Wing Wall

062. Extensive Cracking at East Abutment Side Wall

063. Cracking and Separation at Southeast Pedestal of West Pier, Typ.

064. Undermining and Aggregate Exposure East Abutment Wing Wall

065. Undermining and Aggregate Exposure West Abutment Wing Wall

STRUCTURE ID: 106 – NELSON CANYON **DATE:** 10/05/2022

NOTABLE DEFICIENCIES

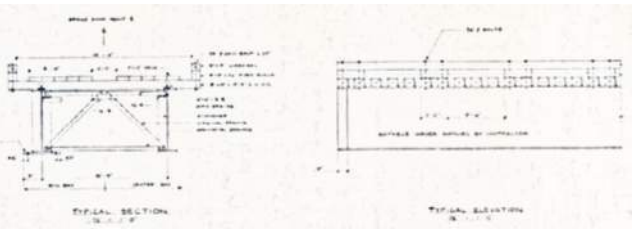
066. Cracking on Asphalt Wearing Surface at West Approach Deck Joint, Typ.

067. Localized Inconsequential Surface Corrosion on Northwest Railing, Typ.

068. Localized Exposed Reinforcing on Deck Parapet at Midspan

STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK **DATE:** 09/07/2022

DESCRIPTION



CONSTRUCTION DATE:	1984	
BRIDGE ORIENTATION:	North - South	
FEATURE SUPPORTED:	Eagle Lake Reservoir Access Road – Private Municipal Road	
FEATURE CROSSED:	Cypress Creek	
SUBSTRUCTURE:	Abutments - concrete spread footings on rock supported by natural logs	
SUPERSTRUCTURE:	Steel girder and lateral bracing with timber floor beams and timber decking	
WEARING SURFACE:	Single-lane timber planking	
APPROACHES:	Gravel road approaches – Sharp corner at south access to bridge, downhill slope to bridge from north approach.	
GENERAL:	SPANS:	1-span: 27.8m
	TOTAL LENGTH:	27.8m
	DECK AREA:	135m^2
	BEARINGS:	Steel
	BANK/PIER PROTECTION	Timber cribbing retaining wall
	GUARDRAIL:	Timber on bridge, boulders line approaches
	CURB:	None
	UTILITIES:	Watermain
	CLEARANCE:	20m
	ROADWAY CLASS:	Private
	SIGNAGE:	Delineators; Load Posting; Stop Signs; Wheel-Placement Instructions to Users
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	2018: Drilling of timber members	
PAST REHABILITATION WORKS:	2005: Watermain recoated at ends, abutments and expansion details reconstructed 2020: RFP Issued for Rehabilitation	

OVERALL CONDITION:	Fair Condition – Urgency Rating = 3
ESTIMATED REMAINING SERVICE LIFE:	37 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (<5 yr) 2. Recoat Girders (~10 yr) 3. Bearing Replacement (~10 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Remove Abutment and Deck Debris Build-up ($2,500) 2. Relash Support Logs at both Abutments ($2,500) 3. Perform Localized Girder and Pipe Support Recoating ($10,000) 4. Replace Bracing Connection Bolts ($2,500) 5. Add TAC Barrier Flares or Crash Attenuators ($10,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Deck and Drainage Channels (~$2,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,500; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed.

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
107	Eagle Lake Road at Cypress Creek	9/8/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

INSPECTION NOTES BY COMPONENT
All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk		100						R	High clearance above Cypress Creek.
2	Channel		100						R	High clearance above Cypress Creek.
3	Erosion Protection			50	50				2	Erosion protection failing at both abutment embankments.
4	Substructure Scour		100						R	No evidence of scour.
	SUBSTRUCTURE									
5	Foundation Movement			75	25				2	No foundation movement but embankment movement could propagate.
6	Abutments			100					R	Abutments in generally fair condition overall.
7	Wing/Retaining Walls			100					R	Integral wing walls in generally fair condition.
8	Embankment				100				2	Embankments vulnerable to failure.
9	Footings/Piling			100					R	Exposed portions of footings in fair condition.
10	Pier Columns/Walls/Cribs							N		
11	Bearings			100					R	No significant issues with bearings.
12	Caps							N		
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		40	50	10				R	Generally good-fair condition except at watermain hanger locations.
18	Portals							N		
19	Bracing/Diaphragms			80	20				1	Bracing in generally fair condition but connection hardware poor.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets			50	50				1	Advanced deterioration of bolts with many bolts fracturing upon test impact.
27	Camber/Sag			100					R	
28	Live Load Vibration			100					R	
29	Coating (structure)			80	20				R	Isolated portions of the bottom flange and web in poor condition.
	DECK									
30	Sub Deck/Cross Ties		45	50	5				1	Generally good-fair condition except isolated pockets due to deck water ingress.
31	Wearing Surface		25	50	25				3	Generally good-fair but significant debris build-up.
32	Deck Joints			50	50				1	Integral abutment expansion joints with significant grade breaks on both ends.
33	Curbs/Wheelguards			100					R	Forestry-style bull rails in generally fair condition.
34	Sidewalk(s)							R		Corroding railing-wellguard connections with missing top anchors.
35	Railings/Parapets			100					R	
36	Median Barrier							N		
37	Drains/Pipes			100					R	
38	Coating (Railings)			70	30				R	
	APPROACHES									
39	Signing/Lighting			100						
40	Roadway Approaches			75	25					
41	Roadway Flares				100					

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

3

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

Posted load rating sign reads: "MAXIMUM 35,000 kg GVW". Another sign instructs that "Cement trucks limited to 75% of their payload capacity" and "Only one vehicle permitted on bridge at any time."

Other Posted Hazard Warning Signs

Delineators installed at all four corners. Stop signs on northeast and southwest corners. There are instructional signs indicating drivers to stop and read the sign, instructing drivers to drive on the downstream side of the bridge on white lines, which are no longer visible.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Black, Cypress, and Hollyburn Mountains, with sections of steep gradient, but the creek is low gradient at the bridge location.

Scour Notes

The bridge lies well above the creek channel and perched on canyon rock walls. There is scour due to water runoff erosion in around the abutment wing walls and foundations.

Rehab Work Notes

Relash the support logs retaining the embankment fills at both abutments. Perform localized girder and watermain support recoating. Replace bracing connection bolts, which are heavily corroded. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. However, given the low usage of this road and the low speed limit for traffic, applying one of the approach barrier recommendations from BC MFLNRORD Standard Bridge Drawing STD-EC-010-05 may be an appropriate substitute for the TAC guideline's approach barrier requirements.

It should be noted that

Maintenance Work Notes

Remove water runoff debris from abutments and bearings. Clean water runoff debris from the deck surface and open up drainage slots to keep water from collecting on the deck for long periods of time. Add half-pipes to ballast wall faces or use other means to direct water runoff from the roadway from flowing over the abutment bearing area. This will reduce future corrosion action and help mitigate debris buildup in those areas.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in fair condition. The steelwork demonstrates local corrosion, but not to a significant degree. The timber decking and cross-ties are in generally good-fair condition due to the heavy creasote treatment. The railings were recently replaced, but are exhibiting corrosion at their base connection. The embankments have the potential to become unstable due to the lack of reliable embankment retention. The abutments and bearings need to be cleaned of the debris accumulated by water runoff on the roadway. It should be noted that while there is no immediate safety concern with the unsecured embankment retaining logs, erosion is ongoing, so mitigative action at this time is likely prudent.

Additional Utility Concern Notes

The watermain supports on the north edge of the bridge exhibit moderate corrosion.

Additional Urgency Rating Notes

The structure is believed to have adequate gravity load capacity for the reduced load rating posted on the bridge approaches; however, the bridge is considered vulnerable to seismic demands.

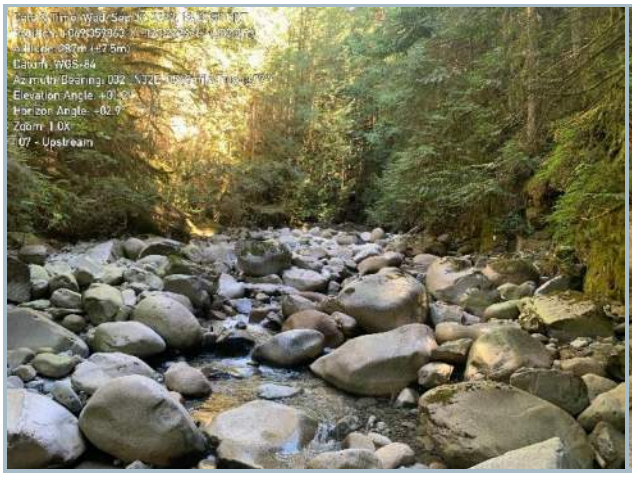
Seismic Vulnerability Notes

The structure does not have a reliable seismic force-resisting system and lies on poorly-retained embankments and therefore the structure is considered to have a high vulnerability to seismic demands.

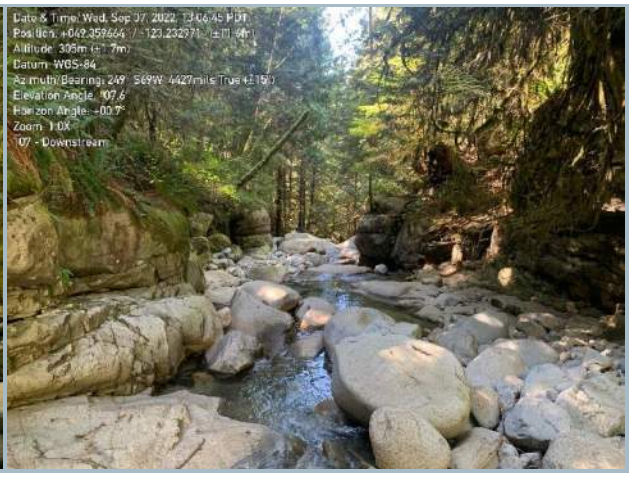
Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK ROAD **DATE:** 09/07/2022

GENERAL ARRANGEMENT



001. Upstream



002. Downstream

003. East Elevation

004. West Elevation

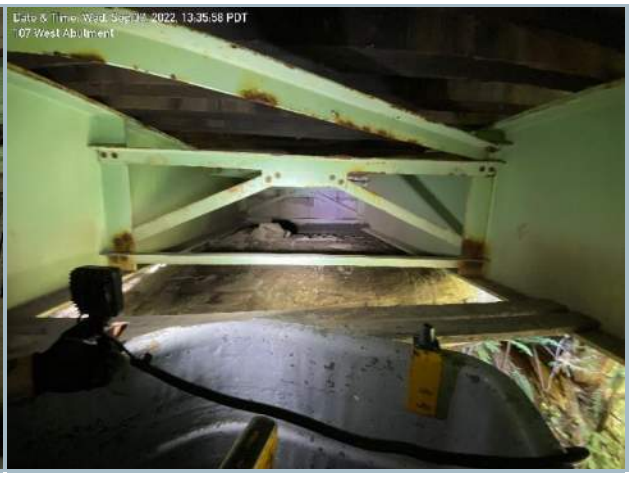
005. South Approach

006. North Approach

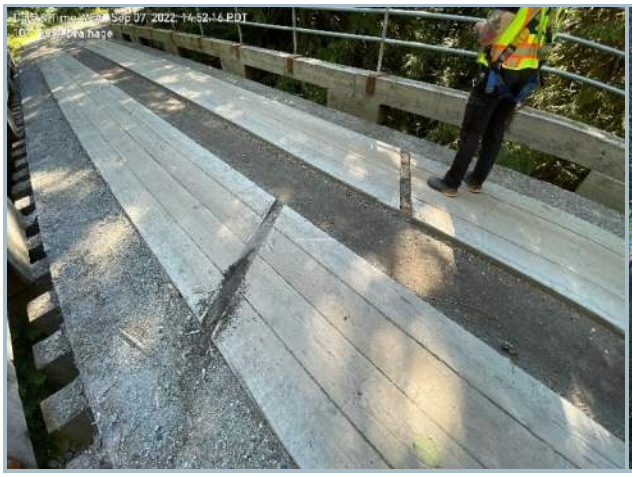
STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK ROAD **DATE:** 09/07/2022

GENERAL ARRANGEMENT

007. South Abutment
(Note: Lock block Back Wall, Typ.



008. North Abutment



009. Bridge Deck

010. Bridge Soffit

STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK ROAD **DATE:** 09/07/2022

CONFIGURATION

011. Bull Rail Connection, Typ.

012. Transverse Beams Bearing on Steel Girders

013. Deck Soffit with Transverse Beams

014. Watermain Utility Along East Profile

015. West Railing Configuration, Typ.

STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK ROAD **DATE:** 09/07/2022

SEISIMIC FORCE REISISTING SYSTEM

016. Lateral Bracing Members with Top Chord Diagonal Braces (Note: Birds Nest)

017. Anchored Steel Bearing Plate, Typ.

STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK ROAD **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

018. Unsecure Timber Crib at North Abutment

019. Unsecure Timber Crib at South Abutment

020. Debris Accumulation at Bearing Plate, Typ.

021. Corroding Utility Pipe Joint

022. Anchor Bolts Not Installed at Rail Connection

023. Degrading Bolts at Cross-brace Gusset Plate

STRUCTURE ID: 107 – EAGLE LAKE ROAD AT CYPRESS CREEK ROAD **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

024. Degrading Bolts on Gusset Plate Connection Subject to Crevice Corrosion

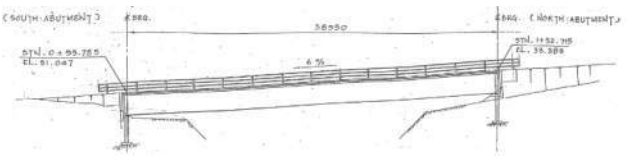
025. Corroding Pipe Hanger, Typ.

026. Intermittent Under Film Corrosion on Bottom Flange of West Girder

027. Rotting Timber Section at Midspan

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

DESCRIPTION



CONSTRUCTION DATE:	1991	
BRIDGE ORIENTATION:	North-South	
FEATURE SUPPORTED:	Keith Place	
FEATURE CROSSED:	Brothers Creek	
SUBSTRUCTURE:	Abutments - Back wall suspended from deck, steel pipe piles under each	
SUPERSTRUCTURE:	Steel girders (350 A, AT) acting compositely with a precast concrete deck	
WEARING SURFACE:	Asphalt topping on pre-cast concrete	
APPROACHES:	Perpendicular to Keith Rd. at South Approach and is in straight-alignment with Keith Place at North Approach	
GENERAL:	SPANS:	1-span: 39.9m
	TOTAL LENGTH:	39.9m
	DECK AREA:	320m^2
	BEARINGS:	Elastomeric
	BANK/PIER PROTECTION:	Integral ballast wall
	GUARDRAIL:	Steel
	CURB:	Concrete
	UTILITIES:	Gas; Watermain
	CLEARANCE:	N/A
	ROADWAY CLASS:	Local
	SIGNAGE:	Gas Pipeline; No Dumping
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	2004 – Positive Material Identification (PMI) tests for material identification 2006 – Load Rating	
PAST REHABILITATION WORKS:	2011 – Painting of girders, asphalt placing, waterproofing and joint sealing	

OVERALL CONDITION:	Fair Condition – Urgency Rating = 3
ESTIMATED REMAINING SERVICE LIFE:	19 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~5 yr) 2. Recoat Girders (~10 yr) 3. Bearing Replacement (~10 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Recoat Bottom Flanges and Bearing Stiffeners of Girders (~$125,000) 2. Repair Deck Panel Joints on Sidewalk Overhang (~$10,000) 3. North Expansion Joint Pavement Resurfacing (~$5,000) 4. Add Delineator and Bicyclist Dismount Signs (~$2,000) 5. Add TAC Barrier Flares or Crash Attenuators (~$9,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Clean Vegetation from Deck Overhangs (~$500; no associated specification). 4. Clean Debris from Bearing Areas (~$500; no associated specification). 5. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 6. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 7. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 8. Install and Confirm Bottom Flange Barriers are in Place, As Needed. 9. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 10. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
108	Keith Place over Brothers Creek	9/8/2022

COMPONENT | **PERCENT CONDITION RATING** Enter % in each condition. See BMIS User Manual 15.2.2 | **INSPECTION NOTES BY COMPONENT** All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

		E	G	F	P	V	X	N	CU	
	HYDROTECHNICAL									
1	Debris Risk		100						R	High clearance above Cypress Creek.
2	Channel		100						R	High clearance above Cypress Creek.
3	Erosion Protection			50	50				2	Erosion protection failing at both abutment embankments.
4	Substructure Scour		100						R	No evidence of scour present.
	SUBSTRUCTURE									
5	Foundation Movement		75	25					2	No foundation movement but embankment movement could propagate.
6	Abutments		100						R	Abutments in generally fair condition overall.
7	Wing/Retaining Walls		100						R	Integral wing walls in generally fair condition.
8	Embankment			100					2	Embankments vulnerable to failure.
9	Footings/Piling		100						R	Exposed portions of footings in fair condition.
10	Pier Columns/Walls/Cribs							N		
11	Bearings			80	20				R	No significant issues with bearings, but bearing stiffeners poor.
12	Caps							N		
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		10	70	10	10			3	Consistent 1-4mm section loss on bot flange with localized spots on top flange.
18	Portals							N		
19	Bracing/Diaphragms			100					R	Bracing in generally fair condition overall.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		50	40	10				1	Crevice and pitting corrosion visible on several connections.
27	Camber/Sag			100					R	
28	Live Load Vibration			100					R	
29	Coating (structure)			75	25				3	Delamination, cracking and blooming of coating indicating coating failure.
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface							N		
32	Deck Joints		20	80						Cracking and spalling around deck joints. Incidences of joint misalignment.
33	Curbs/Wheelguards			100					R	
34	Sidewalk(s)			90	10				2	Grade break at north abutment due to settlement of approach fills.
35	Railings/Parapets			100					R	
36	Median Barrier							N		
37	Drains/Pipes			100					R	
38	Coating (Railings)			70	30				R	
	APPROACHES									
39	Signing/Lighting			100						
40	Roadway Approaches			75	25					
41	Roadway Flares				100					

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

3

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Gas Pipeline signs on the southeast and northeast corners of the bridge. No Dumping sign on northwest corner of the bridge.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has low gradient at the bridge site.

Scour Notes

The abutments are set well back from the channel edge, which is partially founded directly on bedrock. The scour at the bottom of both embankments is minimal.

Rehab Work Notes

The bridge's steel plate girders, which are weathering steel, were coated in 2011. This coating is now failing on the top surface of the bottom flanges and the bearing stiffeners at the abutments. Repair failing deck panel joints, particularly on the sidewalk overhangs. Resurface north expansion joint pavement. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering the heavy bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Maintenance Work Notes

Reinstall bottom flange barriers to prevent public from walking out on the flanges over the span. The existing bottom flange barriers are either in disarray or have been removed altogether and left on the ground around the structure. Add delineator signs to all four bridge corners.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

The steel girder coating failure on the bottom flanges of the superstructure appears to have led to significant section loss in some locations, particularly at the south abutment bearings. Recoating of the top surface of the girder bottom flange may help arrest the corrosion propogation. The sidewalk overhang joints are in generally poor condition, whereas the joints under the roadway surface are generally fair. There is evidence of significant approach fill settlement on the north approach at the sidewalk location. Judging by the sidewalk deterioration, this may be an ongoing issue. The structure is in overall fair condition.

Additional Utility Concern Notes

The utility supports are in generally good-fair condition.

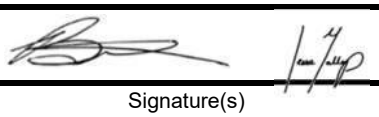
Additional Urgency Rating Notes

Recoating of the top surface of the bottom flange will help further reduce section loss of the bottom flange and loss of capacity of the bridge. Repair of the deck and sidewalk joints will also act to mitigate the corrosion of the bottom flange of the girders. The structure is also considered to be vulnerable to seismic demands.

Seismic Vulnerability Notes

The structure has a vulnerable substructure with pipe towers on each abutment, each with different heights above bedrock. The structure is not expected to perform well under seismic loading, despite a relatively strong connection between the superstructure and the abutment ballast walls. There is minimal connection between the superstructure/ballast walls and the pipe tower foundations.

Brook Robazza, Jesse Gallop
Inspector(s) (please type or print)


Signature(s)

Brook Robazza
Professional Engineer (EoR) (please type or print)


Signature(s)

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream

003. North Elevation

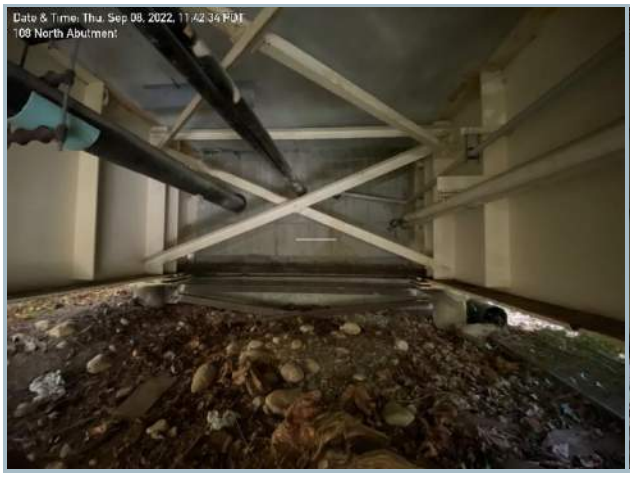
004. West Elevation

005. North Approach

006. South Approach

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

GENERAL ARRANGEMENT



007. North Abutment

008. South Abutment

009. Bridge Deck

010. Bridge Soffit

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

CONFIGURATION

011. South Approach Slab Joint

012. North Approach Slab Joint

013. North Riverbank

014. South Riverbank

015. Southwest Wingwall Configuration, Typ.

016. Watermain and Gas Utility, Typ.

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

CONFIGURATION

017. West Railing Configuration, Typ.

018. Girder Splice Connection, Typ.

019. Sidewalk along East Profile

020. Sidewalk Soffit along East Profile, Typ.

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

SEISIMIC FORCE REISISTING SYSTEM

021. Anchored Steel and Elastomer Bearing Plate, Typ. 022. Intermittent Lateral Cross-bracing, Typ.

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

NOTABLE DEFICIENCIES

023. Coating Failure on Bottom Flange of Girder at Southwest Corner

014. Stiffener Section Loss at Southwest Corner

015. Coating Failure at Bearing Plate of South Abutment

016. Localized Sections of Coating Failure at Bottom Flange of South Girder, Typ.

017. Localized Sections of Coating Failure at Splice Locations, Typ.

018. Separation in Concrete and Spalling Occurring at Deck Joints, Typ.

STRUCTURE ID: 108 – KEITH PLACE OVER BROTHERS CREEK **DATE:** 09/08/2022

NOTABLE DEFICIENCIES

019. 1.25" Concrete Void at Deck Joint Viewed from Sidewalk Soffit

020. 1.5" Concrete Void at Deck Joint Viewed Along East Profile

021. Exposed Reinforcing Adjacent to Deck Joint Separation (Note Extensive Cracking Emanating from Deck Joint)

022. Localized Sections of Exposed Reinforcing along Deck Soffit

STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

DESCRIPTION

CONSTRUCTION DATE:	1964	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Millstream Road	
FEATURE CROSSED:	Brothers Creek	
SUBSTRUCTURE:	Abutments - Spread Footings	
SUPERSTRUCTURE:	Cast-in-place concrete beams and deck	
WEARING SURFACE:	2-Lane asphalt overlay	
APPROACHES:	The bridge is in straight-alignment with the east approach. Aligned poorly with the west approach as Millstream Road turns abruptly south while on a descending grade	
GENERAL:	SPANS:	1-span: 8.0m
	TOTAL LENGTH:	8.0m
	DECK AREA:	64m2
	BEARINGS:	N/A
	BANK/PIER PROTECTION:	Natural bedrock
	GUARDRAIL:	Galvanized steel
	CURB:	Concrete
	UTILITIES:	Sanitary; Gas; Watermain
	CLEARANCE:	6m
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Load Posting; Fish-bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	2018: chain drags performed during principal inspections	
PAST REHABILITATION WORKS:	1994: Watermain insulated 1997: Gap in guardrails closed off 2004: Broken weld repaired, hazards signs installed, new asphalt at west approach, southeast corner barrier stabilized	

OVERALL CONDITION:	Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	17 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~15 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Perform Localized Spall Repairs on Abutments (~$3,000) 2. Perform Localized Spall Repairs on Girder Webs (~$3,000) 3. Add Bicyclist Dismount Signs (~$1,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Clean Vegetation from Deck Overhangs (~$500; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
109	Millstream Road over Brothers Creek	9/7/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

INSPECTION NOTES BY COMPONENT
All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk			50	50				R	Due to stream-diversion walls downstream, debris build up potential is high.
2	Channel			30	70				R	The creek channel is heavily crowded by abutment and downstream walls.
3	Erosion Protection		50	50					R	Generally well-protected by bedrock foundations.
4	Substructure Scour			100					R	No current issues.
	SUBSTRUCTURE									
5	Foundation Movement	90	10						R	On bedrock; location of undermining at east side of downstream guide wall.
6	Abutments		70	20	10				R	Localized areas spalling and exposed reinforcing at pipe opening.
7	Wing/Retaining Walls		80	20					R	Spalling around pipe openings showing exposed aggregate on concrete.
8	Embankment		75	25					R	Generally good, with abutment cast directly on bedrock. Steep slopes are present.
9	Footings/Piling			100					R	Abutments cast directly on bedrock, with minor cracking around the interface.
10	Pier Columns/Walls/Cribs			90	10				2	Localized areas spalling and exposed reinforcing at pipe opening.
11	Bearings							N		Fully cast-in-place integral structure.
12	Caps			90	10				1	Some original cracks remain at construction joints from the original construction.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		80	15	5				R	Exposed reinforcing on girder webs and flanges observed from deck soffit.
18	Portals							N		
19	Bracing/Diaphragms							N		
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets							N		
27	Camber/Sag			100						No significant sag issues.
28	Live Load Vibration			100						No live load vibration issues.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		50	50					R	Wearing surface in generally good-fair condition.
32	Deck Joints		50	50					R	Deck joints in generally good-fair condition
33	Curbs/Wheelguards								R	Staining on girder flange along parapets indicating moisture ingress.
34	Sidewalk(s)							N		No designated sidewalk but this is a low volume road.
35	Railings/Parapets			95	5					
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)			95	5					
	APPROACHES									
39	Signing/Lighting			100						
40	Roadway Approaches			100						
41	Roadway Flares			80	20					

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

Posted load rating sign reads: "BRIDGE LOAD LIMIT 45,000 kg, GVW".

Other Posted Hazard Warning Signs

Delineator signs present on all four corners of the bridge. Fish-bearing stream creek sign on northwest bridge corner.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, including at the bridge location.

Scour Notes

No significant scour present, except downstream under retaining walls constructed by a private landowner.

Rehab Work Notes

Perform localized spall repairs on abutment walls, deck soffit, and girder webs. Add anodes to the repairs in these areas to mitigate future corrosion progression. Add bicycle dismount signs.

Maintenance Work Notes

Clean deck of forest debris.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in fair condition, with the primary item of concern being the spalling and exposed reinforcement at the deck soffit, abutment walls, and girder webs. The creek channel is quite crowded, but this cannot be easily mitigated against.

Additional Utility Concern Notes

A small water main is suspended below deck, which exhibits evidence of deterioration, particularly at the abutment wall connections.

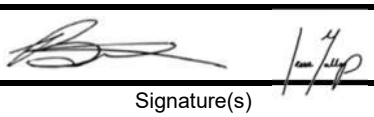
Additional Urgency Rating Notes

The structure is in overall fair condition, with the primary deterioration mechanisms being localized spalling of corroded reinforcement. The seismic vulnerability is expected to be low due to the robustness of the structural configuration and the relatively low expected seismic demands.

Seismic Vulnerability Notes

This short-span structure is fully integral from the superstructure to the foundations, which are directly case on bedrock. The seismic demands are therefore not expected to be significant and liklely within the capacity of the substructure.

Brook Robazza, Jesse Gallop
Inspector(s) (please type or print)


Signature(s)

Brook Robazza
Professional Engineer (EoR) (please type or print)


Signature(s)

STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

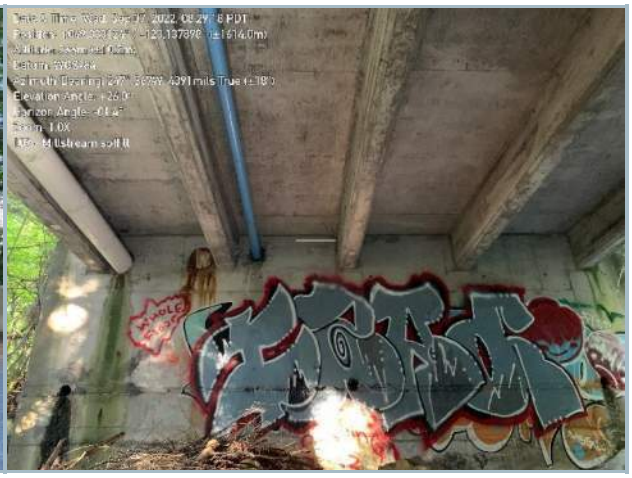
STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. Bridge Deck



010. Bridge Soffit

STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

CONFIGURATION

011. Rail-Barrier Transition, Typ.

014. Utility Lines at North Profile

015. West Approach Slab Joint

016. East Approach Slab Joint

SEISMIC FORCE REISISTING SYSTEM

017. Precast Concrete Stringers with Integral Abutment and Concrete Deck Diaphragm

STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

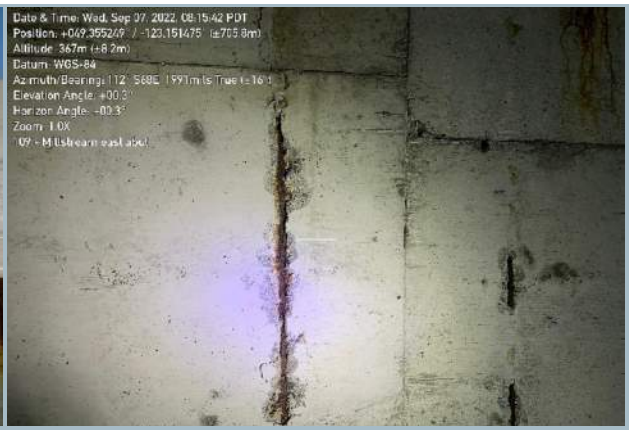
018. Exposed Reinforcing along Girder 5 Soffit (Southmost Girder)

019. Exposed Reinforcing along Girder 1 Soffit (Northmost Girder)

020. Exposed Reinforcing along Girder 2 (From North Profile)

021. Exposed Reinforcing along Girder 1 (From North Profile)

022. Concrete Spalling and Exposed Reinforcing at Utility Pipe Connection at East Abutment



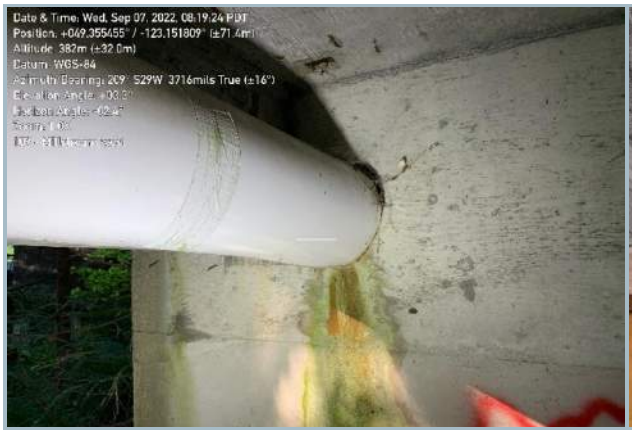
023. Exposed Reinforcing at East Abutment

STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

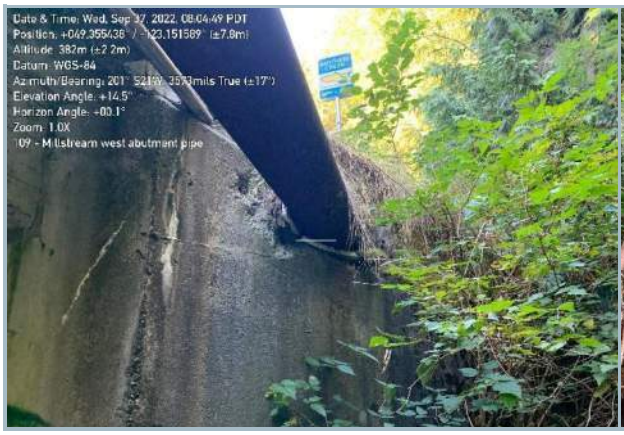
024. Staining of Deck Soffit at Southmost Girder

025. Spalling and Staining of Drain Outlet at West Abutment



026. Staining of Utility Line at West Abutment

027. Spalling and Staining Around Gas Utility Line at West Abutment



028. Spalling and Staining of Utility Line Connection at Northwest Wing Wall

029. Spalling and Staining of Utility Line Connection at Northeast Wing Wall

STRUCTURE ID: 109 – MILLSTREAM ROAD OVER BROTHERS CREEK **DATE:** 09/07/2022

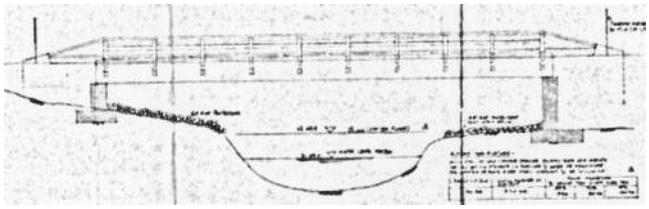
NOTABLE DEFICIENCIES

024. Undermining at South Section of West Abutment

025. Excessive Vegetation Supported by Wing Wall

STRUCTURE ID: 110 – SINCLAIR COURT OVER LAWSON CREEK **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	1995	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Sinclair Court	
FEATURE CROSSED:	Lawson Creek	
SUBSTRUCTURE:	Abutments – semi-integral reinforced concrete on spread footings	
SUPERSTRUCTURE:	Prestressed concrete box girders	
WEARING SURFACE:	Unsurfaced	
APPROACHES:	Asphalt roadway is in straight-alignment with bridge	
GENERAL:	SPANS:	1-span: 18m
	TOTAL LENGTH:	18m
	DECK AREA:	133m^2
	BEARINGS:	Neoprene
	BANK/PIER PROTECTION:	Concrete wingwalls, rip-rapped
	GUARDRAIL:	Steel
	CURB:	Concrete
	UTILITIES:	Gas; Watermain; Electrical ducts
	CLEARANCE:	N/A
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Gas Pipeline
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	48 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Reposition or Add Riprap to Embankments (~10 yr) 2. Resurface Bridge Deck and Approaches (~20 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Replace Shifted Riprap, Particularly at Southeast Corner (~$10,000) 2. Add Delineator Signs (~$1,000) 3. Reattach Kickplate at Southeast Corner of Bridge Railing (~$500) 4. Add TAC Barrier Flares or Crash Attenuators (~$9,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Sidewalk and Gutters (~$1,000; no associated specification). 3. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 4. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 5. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 6. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 7. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
110	Sinclair Court over Lawson Creek	9/5/2022

COMPONENT | **PERCENT CONDITION RATING** Enter % in each condition. See BMIS User Manual 15.2.2 | **INSPECTION NOTES BY COMPONENT** All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

		E	G	F	P	V	X	N	CU	
	HYDROTECHNICAL									
1	Debris Risk			50	50				1	Evidence of channel constriction and debris build-up.
2	Channel			50	50				1	Tight bend in the creek just downstream of the bridge.
3	Erosion Protection			25	50	25			3	Both abutments affected by riprap failure, especially east abutment.
4	Substructure Scour		25		50	25			3	Significant scour affect east riverbank and at southeast corner of the bridge.
	SUBSTRUCTURE									
5	Foundation Movement		100						R	Bridge generally overspans the creek, except southeast corner.
6	Abutments		100						R	No structural issues with the abutments.
7	Wing/Retaining Walls		50	50					R	No issues with wing walls, which transition to lockblock retaining walls.
8	Embankment				75	25			3	High scour potential at both riverbanks, with limited effective riprap.
9	Footings/Piling		75	25					R	No issues with footings, but south corner at east abutments is undermining.
10	Pier Columns/Walls/Cribs							N		
11	Bearings		100						R	Girders appear to be bearing on a grout pad with no visible issues.
12	Caps		100						R	Abutment/caps in good condition.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders	50	50						R	All girders in either good or very good condition.
18	Portals							N		
19	Bracing/Diaphragms		100						R	No issues with exposed portions of end diaphragms.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets							N		
27	Camber/Sag		100						R	No issues with sag.
28	Live Load Vibration		100						R	No noticeable LL vibration.
29	Coating (structure)							N		No coatings.
	DECK									Utility Concern Notes (Contact Utility Owner):
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		90	10					R	Wearing surface generally good aside for minor damage at joints.
32	Deck Joints		25	75					1	Typical deck joint performance with minor damage in asphalt.
33	Curbs/Wheelguards			90	10				3	Generally fair except for loose kick plate at southeast deck corner.
34	Sidewalk(s)			90	10				1	Minor surface deviation at both deck edges.
35	Railings/Parapets		85	15						
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)		100						R	
	APPROACHES									
39	Signing/Lighting		25			75			3	
40	Roadway Approaches		100						R	
41	Roadway Flares			100					R	

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineator signs present on three corners of the bridge. Gas Pipeline sign on both south corners of bridge.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Blue Gentian Lake on Hollyburn Mountain, with sections of steep gradient, but the creek has relatively low gradient at the bridge

Scour Notes

Significant scour has affected the east riverbank and particularly at the southeast corner of the bridge. The abutment footing at this location is starting to become exposed and the embankment is becoming vulnerable to global failure. The original riprap on both riverbanks has shifted downstream.

Rehab Work Notes

Reposition and replace riprap on both banks of the creek. Key-in riprap on south end of the east abutment and build up significant riprap along toe of the embankment. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering potential bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Note that due to the configuration of the bridge abutments and approaches, semi-specialized equipment, such as a long-arm excavator, is likely required to gain access to the south end of east abutment to install additional erosion protection at that location. Also of note, it is likely that erosion protection will likely need to be customized from the standard BC MoTI guidelines to suit the channel location and it's proximity to the bridge abutment.

Maintenance Work Notes

Reattach kickplate at southeast corner of the bridge railing. Minor fire damage to the watermain casing should be repaired to ensure adequate insulation is still available. Add three delineator signs on approaches, which are currently missing.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with the only area of significant concern is the scour at the south side of the east abutment.

Additional Utility Concern Notes

There appears to be a small amount of fire damage to the watermain insulation near the east abutment. It is recommended to repair the damage to ensure that the watermain is adequately insulated.

Additional Urgency Rating Notes

Aside from riprap required at the south end of the east abutment, the condition of the structure is generally good-fair. The seismic vulnerability is also considered low due to the robustness of the structural configuration, despite relatively poor soil conditions compared to most of the other structures in the inspection program.

Seismic Vulnerability Notes

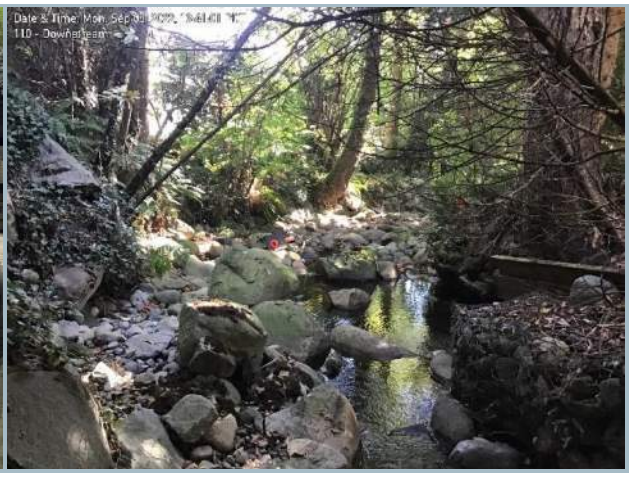
This single-span structure is founded on relatively loose embankment fills. The articulation is semi-integral and is expected to perform reasonably well at transferring seismic demands from the superstructure to the foundations.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 110 – SINCLAIR COURT OVER LAWSON CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. Upstream



002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 110 – SINCLAIR COURT OVER LAWSON CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. Bridge Deck

010. Bridge Soffit

STRUCTURE ID: 110 – SINCLAIR COURT OVER LAWSON CREEK **DATE:** 09/05/2022

CONFIGURATION

011. North Railing, Typ.

012. Railing Connection, Typ.

013. Utility Configuration Supported by Bridge (Note Dislodged Retaining Wall Section

014. Stormwater Manhole Within Creek Bed

STRUCTURE ID: 110 – SINCLAIR COURT OVER LAWSON CREEK **DATE:** 09/05/2022

SEISIMIC FORCE REISISTING SYSTEM

015. Prestressed Box Girders Bearing on Semi-Integral Abutment

NOTABLE DEFICIENCIES

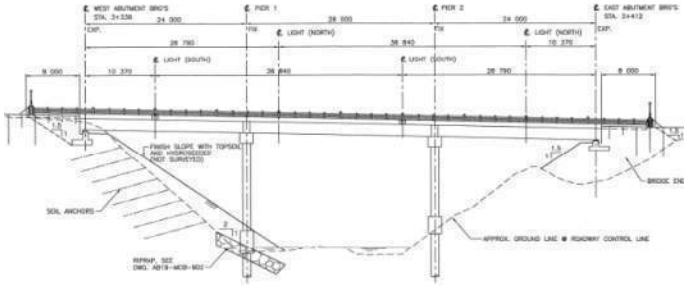
016. Dislodged Bottom Rail at Southeast Corner

017. Debris Accumulation Within Channel

018. Degrading Timber Retaining Wall at Northeast Corner

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

DESCRIPTION



CONSTRUCTION DATE:	2002	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Chippendale Road	
FEATURE CROSSED:	McDonald Creek Main Branch	
SUBSTRUCTURE:	Abutments - Reinforced concrete on spread footings Piers - Concrete piers and columns supported by concrete pile cap and piles	
SUPERSTRUCTURE:	Prestressed concrete I-girders composite with a cast-in-place concrete deck	
WEARING SURFACE:	Asphalt	
APPROACHES:	Asphalt roadway is in straight-alignment with bridge	
GENERAL:	SPANS:	3-span; 25.9m-25.9m-25.9m
	TOTAL LENGTH:	77.6m
	DECK AREA:	871m^2
	BEARINGS:	Elastomeric
	BANK/PIER PROTECTION:	None
	GUARDRAIL:	Steel
	CURB:	Concrete
	UTILITIES:	Gas; Storm Sewer; Watermain
	CLEARANCE:	17m
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Fish-Bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	55 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~5 yr) 2. Bearing Replacement (~15 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Perform Localized Spall Repairs to Deck Soffit (~$10,000) 2. Perform Localized Spall Repairs on Girder Flange (~$5,000) 3. Protect/Regrade Edges of Shotcreted West Embankment (~$7,500) 4. Bicyclist Dismount Signs (~$1,000) 5. Add TAC Barrier Flares or Crash Attenuators (~$10,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
111	Chippendale Road over McDonald Creek	9/7/2022

	COMPONENT	PERCENT CONDITION RATING (Enter % in each condition. See BMIS User Manual 15.2.2) E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT (All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.)
	HYDROTECHNICAL									
1	Debris Risk		100						R	Piers are set high above channel edges.
2	Channel		100						R	Channel is essentially unimpeded by the structure.
3	Erosion Protection		35	50	15				R	Erosion debris building up on shotcrete slope at west embankment. Stream good.
4	Substructure Scour								R	No significant scour.
	SUBSTRUCTURE									
5	Foundation Movement		75	15	10				R	Generally minimal movement except for shotcrete cracking at west embankment.
6	Abutments		75	25					R	Generally good condition.
7	Wing/Retaining Walls		75	25					R	Generally good condition.
8	Embankment		20	60	20				R	Good-fair except for movement/cracking at west embankment.
9	Footings/Piling		75	25					R	Generally good condition where visible.
10	Pier Columns/Walls/Cribs		100						R	Generally good condition.
11	Bearings		100						R	No bearing issues.
12	Caps		85	10	5				R	A few locations with minor spalling due to localized bar corrosion.
13	Corbels							N	R	
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		95	5					R	Single location of exposed reinforcing at girder flange.
18	Portals							N		
19	Bracing/Diaphragms								R	
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		90	10				N		Connections include bolts are in generally good condition for the superstructure.
27	Camber/Sag		100						R	No sag issues.
28	Live Load Vibration		100						R	No noticeable LL vibration.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		50	25	15				2	Generally good-fair except at expansion joint zone and ends of approach slabs.
32	Deck Joints		50	30	20				R	Expansion joints good-fair below deck but poorly detailed at deck level.
33	Curbs/Wheelguards		15	70	5				R	Only relatively minor localized damage.
34	Sidewalk(s)		35	60	5				R	Efflorescence at joint locations observed from parapet soffit and parapet profles.
35	Railings/Parapets		80	20					R	
36	Median Barrier							N		
37	Drains/Pipes		90	10						
38	Coating (Railings)		45	50	5					
	APPROACHES									
39	Signing/Lighting			50	50					
40	Roadway Approaches		50	50						
41	Roadway Flares			20	70					

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineators installed at all four corners. Fish-bearing creek signs on northwest and southeast bridge corners.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has moderate gradient at the bridge site.

Scour Notes

The bridge significantly overspans the creek and the only small amount of scour present is constrained to the limited riprap along the channel.

Moderate erosion of the west embankment around the shotcreted area of the embankment.

Rehab Work Notes

Perform localized spall repairs on deck soffit and girder flanges. Add anodes to the repairs in these areas to mitigate future corrosion progression. Protect edges of shotcreted area on west embankment to prevent undermining and further erosion. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering the heavy bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Maintenance Work Notes

Add bicycle dismount signs. Monitor deck joints in asphalt for further deterioration. Monitor erosion of west embankment, particularly at the north end of the west abutment.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with the primary area of concern being minor erosion and undermining of shotcreted area on the west embankment. A forward-facing retaining wall at the north end of the west abutment is no longer retaining fill as was likely intended. This does not pose a safety concern itself, but does indicate that significant erosion of that embankment may have occurred following construction.

Additional Utility Concern Notes

Watermain and connections in relatively good condition.

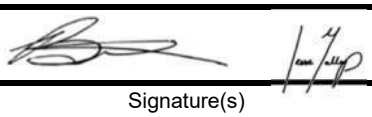
Additional Urgency Rating Notes

Overall, the only repair item of low to moderate urgency is the shotcrete erosion protection at the west abutment. The seismic vulnerability is expected to be low.

Seismic Vulnerability Notes

The structure appears to have an adequate seismic force-resisting system, although it was designed to previous code requirements and seismic hazards.

Brook Robazza, Jesse Gallop
Inspector(s) (please type or print)


Signature(s)

Brook Robazza
Professional Engineer (EoR) (please type or print)


Signature(s)

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

007. East Abutment (Note Boulder Embankment with Geogrid)

008. West Abutment

009. East Pier Abutment

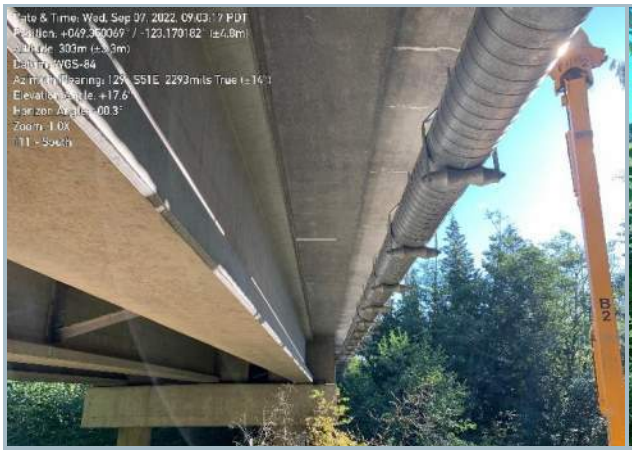
010. West Pier Abutment

011. Bridge Deck

012. Bridge Soffit

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

CONFIGURATION



013. South Profile Overhang Soffit
(Note Intermittent Efflorescence)

014. North Profile Overhang Soffit
(Note Intermittent Efflorescence)

015. Utility Pipe Along South Profile

016. Utility Pipe Along South Profile

017. Lateral Utility Pipe Support, Typ.

018. Sidewalk along North Profile and
Boulevard along South Profile

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

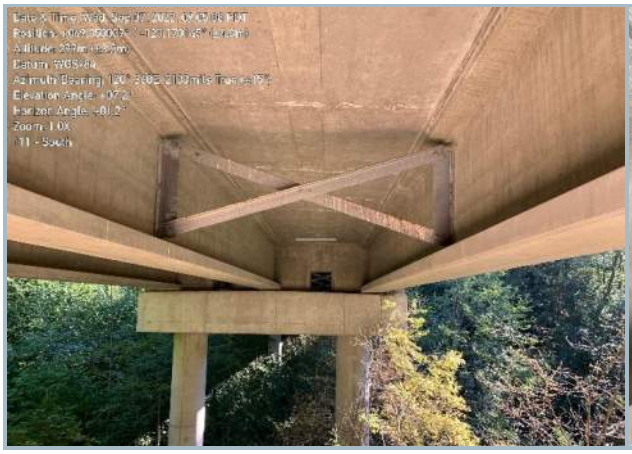
CONFIGURATION

019. West Approach Slab Joint

014. East Approach Slab Joint

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

SEISMIC FORCE REISISTING SYSTEM



013. Lateral Bracing at Midspan, Typ.

014. Shear Key at Pier Abutment, Typ.

015. Bearing Seat at Pier Abutment, Typ.

016. Deep Foundation, Typ.

017. Elastomeric Bearing at South Section of West Abutment (Note: Elastomeric Pad on Short Side Wall Restraint)

018. Elastomeric Bearing at North Section of West Abutment (Note: Elastomeric Pad on Short Side Wall Restraint)

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

SEISIMIC FORCE REISISTING SYSTEM

019. Elastomeric Bearing at North Section of East Abutment (Note: Elastomeric Pad on Short Side Wall Restraint)

020. Elastomeric Bearing at South Section of East Abutment (Note: Elastomeric Pad on Short Side Wall Restraint)

021. West Pier Pile Cap

022. East Pier Pile Cap

STRUCTURE ID: 111 – CHIPPENDALE ROAD OVER MCDONALD CREEK **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

023. Intermitting Efflorescence along Overhang Soffit of North Profile

024. Intermitting Efflorescence along Overhang Soffit of South Profile

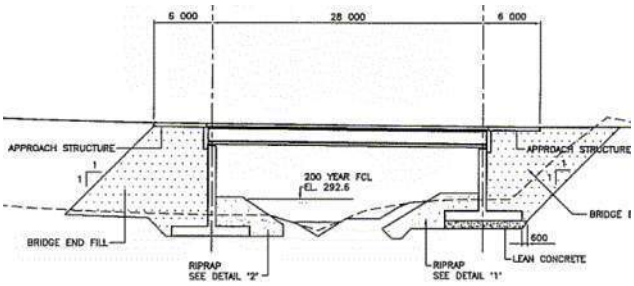
025. Localized Exposed Reinforcing at Midspan of Central Girder (Adjacent to West Pier)

026. Cracking of Shotcrete on West Embankment

027. Wing Wall at Northwest Section Not Retaining Fill

STRUCTURE ID: 112 – CHIPPENDALE ROAD OVER MARR CREEK **DATE:** 09/07/2022

DESCRIPTION



CONSTRUCTION DATE:	2004	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Chippendale Road	
FEATURE CROSSED:	Marr Creek	
SUBSTRUCTURE:	Abutments - Reinforced concrete on spread footings with MSE wingwalls	
SUPERSTRUCTURE:	3-Prestressed concrete I-girders composite with a cast-in-place concrete deck	
WEARING SURFACE:	Asphalt	
APPROACHES:	Asphalt roadway is in straight-alignment with bridge	
GENERAL:	SPANS:	1 -span
	TOTAL LENGTH:	28m
	DECK AREA:	314m^2
	BEARINGS:	Neoprene
	BANK/PIER PROTECTION:	None
	GUARDRAIL:	Steel
	CURB:	Concrete
	UTILITIES:	Gas; Watermain
	CLEARANCE:	6m
	ROADWAY CLASS:	Local
	SIGNAGE:	Fish-bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	57 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~15 yr) 2. Bearing Replacement (~15 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Perform Localized Spall Repairs to Deck Overhang Soffit (~$5,000) 2. Add Delineator and Bicyclist Dismount Signs (~$2,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
112	Chippendale Road over Marr Creek	9/7/2022

	COMPONENT	PERCENT CONDITION RATING (Enter % in each condition. See BMIS User Manual 15.2.2) E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT (All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.)
	HYDROTECHNICAL									
1	Debris Risk			75	25				R	Debris buildup could threaten abutment embankments if damming occurs.
2	Channel			100					R	Mild skew to wate flow with bridge significantly overspanning active channel.
3	Erosion Protection		25	50	25				R	Good-fair riprap armouring adjacent to creek but poor in front of abutments.
4	Substructure Scour			100					R	No significant scour present.
	SUBSTRUCTURE									
5	Foundation Movement			100					R	No evidence of foundation movement.
6	Abutments		50	50					R	Generally good-fair condition.
7	Wing/Retaining Walls			95	5				R	Staining of wing wall indicating egress of moisture.
8	Embankment			75	25				R	Upper portions of slope are unprotected.
9	Footings/Piling			100					R	Exposed portions of footings are in fair condition.
10	Pier Columns/Walls/Cribs							N		
11	Bearings		70	30					R	Minor bulging of elastomers.
12	Caps							N		
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		80	15	5				R	Spot locations of exposed reinforcing along soffit of deck parapet.
18	Portals							N		
19	Bracing/Diaphragms							N		
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets							N		
27	Camber/Sag			100					R	No camber issues.
28	Live Load Vibration			100					R	No live load vibration issues.
29	Coating (structure)			100					R	Structure coatings at light standard and railing connections in fair condition.
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		25	75					R	Generally good-fair except at deck joint locations.
32	Deck Joints			75	25				1	Deck joints recently repaired but surrounding asphalt deteriorated. Sidewalks poor.
33	Curbs/Wheelguards			95	5				R	Curbs in generally fair condition except for minor impact damage.
34	Sidewalk(s)			100					R	Sidewalks in fair condition.
35	Railings/Parapets			100					R	
36	Median Barrier							N		
37	Drains/Pipes			100					R	
38	Coating (Railings)		90	10					R	
	APPROACHES									
39	Signing/Lighting			50	50				R	
40	Roadway Approaches		100						R	
41	Roadway Flares		50	25	25				R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Fish-bearing creek signs on northwest and southeast bridge corners.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has moderate gradient at the bridge site.

Scour Notes

The bridge significantly overspans the creek and the only small amount of scour present is constrained to the limited riprap along the channel.

Rehab Work Notes

Perform localized spall repairs on deck overhang soffits. Add anodes to the repairs in these areas to mitigate future corrosion progression.

Maintenance Work Notes

Add delineator and bicycle dismount signs. Monitor deck joints in asphalt for further deterioration.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with no major areas of concern.

Additional Utility Concern Notes

Watermain and connections in relatively good condition.

Additional Urgency Rating Notes

Overall the structure is in generally good condition, with an expected low vulnerability to seismic demands.

Seismic Vulnerability Notes

The single-span structure is expected to have low vulnerability to seismic demands. The tall retaining wall on the south sides of both abutments could represent a potential concern, but due to the relatively recent construction of the bridge, they are expected to exhibit adequate seismic performance.

Brook Robazza, Jesse Gallop

Inspector(s) (please type or print)

Signature(s)

Brook Robazza

Professional Engineer (EoR) (please type or print)

Signature(s)

STRUCTURE ID: 112 – CHIPPENDALE ROAD OVER MARR CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 112 – CHIPPENDALE ROAD OVER MARR CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. Bridge Deck (Note West Approach Slab Joint)

010. Bridge Soffit

STRUCTURE ID: 112 – CHIPPENDALE ROAD OVER MARR CREEK **DATE:** 09/07/2022

CONFIGURATION

013. East Embankment
(Note Debris Accumulation in Creek Bed)

014. Stormwater Drainage on Deck, Typ.

015. Utility Pipes Along South Interior Section

016. Utility Pipe Along North Interior Section

017. Upstream Water Extraction System

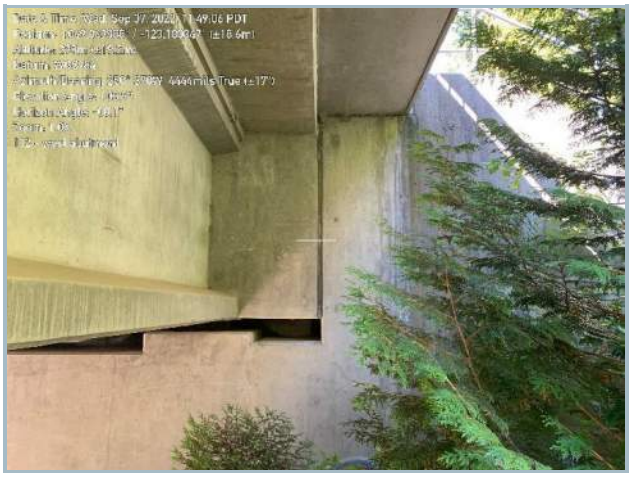
018. Southwest Sidewall

STRUCTURE ID: 112 – CHIPPENDALE ROAD OVER MARR CREEK **DATE:** 09/07/2022

SEISIMIC FORCE REISISTING SYSTEM

013. Single Shear Key at Abutment, Typ.

014. Elastomeric Bearing, Typ.



015. Semi-integral Abutment, Typ.

STRUCTURE ID: 112 – CHIPPENDALE ROAD OVER MARR CREEK **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

016. Void at Utility Pipe Connection

017. Localized Exposed Reinforcing along North Profile

018. Minor Coating Failure on South Railing

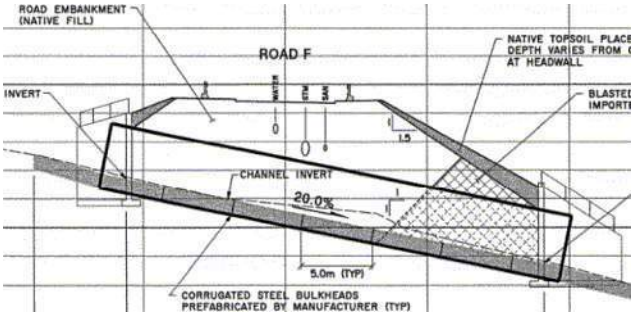
019. Minor Cracking on Asphalt Wearing Surface at Midspan

020. Minor Efflorescence at North Profile

021. Cracking of Asphalt Wearing Surface at East Approach Joint

STRUCTURE ID: 113 – CHIPPENDALE ROAD OVER MCDONALD CREEK WEST **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	2004	
CULVERT ORIENTATION:	North-South with 20% Downhill Grade	
FEATURE SUPPORTED:	Chippendale Road, 2 lane, residential roadway. With sidewalk and small boulevard	
WATERWAY:	McDonald Creek – West Branch	
STRUCTURE:	Multiplate Corrugated Metal Arch Culvert running under Chippendale Road	
WEARING SURFACE:	2-lane asphalt wearing surface with sidewalk and small boulevard	
APPROACHES:	Asphalt roadway in-line with Chippendale Rd.	
	TOTAL LENGTH:	Single – 40m long: 4.6m x 2.7m arch culvert; galvanized
	INLET INVERT ELEVATION:	333.38m
	OUTLET INVERT ELEVATION:	327.50m
	UTILITIES (IN COVER FILL):	Watermain; Storm; Sanitary
	SIGNAGE:	Single-File; Fish-bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	
OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2	
ESTIMATED REMAINING SERVICE LIFE:	57 yr (based on original construction date and inspection findings)	
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Fill Above Culvert and Approaches (~20 yr) 2. Coat Interior of Culvert Pipe (~20 yr)	
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Regrade Substrate in Culvert to Reduce Fish Obstacles (~$10,000) 2. Rebolt Multi-Plate Connections at Inlet (~$2,000)	
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years	
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Touch-Up Coating of Galvanized Steel Railings and Culvert Pipe Walls (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 3. Remove Debris from Culvert Interior (~$1,500; no associated specification). 4. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 5. Tighten Loose Culvert Splice Bolts to Snug-Tight Condition, As Needed. 6. Reseal Asphalt Deck Joints and Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).	

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	113	Structure Name	Chippendale Road Culvert over McDonald Creek West	Inspection Date (yyyy/mm/dd)	9/5/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

INSPECTION NOTES BY COMPONENT
All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk			100					R	Large diameter pipe, but with interior baffles that could catch debris.
2	Channel			90	10				R	Some minor channel crowding on east side of upstream channel edge.
3	Erosion Protection			80	20				R	Heavy riprap at inlet and outlet, but gradation is somewhat poor.
4	Substructure Scour			80	20				R	Minor scour at inlet and more signficant scour at internal bulkheads.
	SUBSTRUCTURE									
5	Foundation Movement		15	80	5				R	Minor deformation of steel culvert near inlet, but not critical.
6	Abutments		30	70					R	Generally good-fair condition head walls.
7	Wing/Retaining Walls		20	80					R	Wing walls in generally good-fair condition.
8	Embankment			100					R	Embankments are steep but stable.
9	Footings/Piling		5	90	5				R	Bottom of culvert in fair condition overall.
10	Pier Columns/Walls/Cribs							N		
11	Bearings							N		
12	Caps							N		
13	Corbels							N		
14	Dolphins/Fenders			100					R	Internal culvert baffles in generally fair condition.
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders							N		
18	Portals		40	50	10				R	Culvert is structurally in generally good-fair condition except localized corrosion.
19	Bracing/Diaphragms							N		
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets							N		
27	Camber/Sag							N		
28	Live Load Vibration							N		
29	Coating (structure)		40	60					R	Coatings in generally good-fair condition.
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		20	80					R	Wearing surface on roadway in generall good-fair condition.
32	Deck Joints							N		
33	Curbs/Wheelguards		50	50					R	Curbs in generally good-fair condition.
34	Sidewalk(s)		50	50					R	Sidewalk in generally good-fair condition.
35	Railings/Parapets		90	10					R	
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)		90	10					R	
	APPROACHES									
39	Signing/Lighting		80	20					R	
40	Roadway Approaches			50	50				R	
41	Roadway Flares		50	50					R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Single-File Vehicle and Bicyclist and fish-bearing stream signs on northeast approach corner and southwest approach corner.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has moderate 20% gradient through the culvert.

Note that culverts with this longitudinal gradient are not common and usually a 5% gradient limit is preferred.

Scour Notes

No significant scour except at the culvert inlet and around all internal bulkheads within the culvert, which is likely inhibiting fish passage within the culvert. An environmental permit is likely required for this work, but it is anticipated that this should not be a prohibitive process as the work should be easily completed within the summer fish window when the creek is experiencing low flows.

Rehab Work Notes

Regrade fill within culvert to remove fish obstacles that are likely inhibiting their passage through the culvert. Riprap around lightly-scoured area around culvert inlet. Delineator signs are required on all four bridge corners.

Maintenance Work Notes

Re-bolt multi-plate connections at culvert inlet.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in generally good-fair condition.

Additional Utility Concern Notes

Utilities are buried in the fill above the culvert pipe structure and could not be directly inspected.

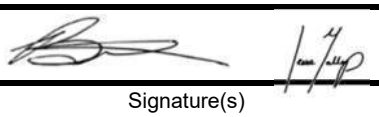
Additional Urgency Rating Notes

There are no immediate structural concerns at this time; however, the scour within the culvert has produced a series of signficant fish obstacles that should be mitigated against as soon as practical.

Seismic Vulnerability Notes

No significant seismic vulnerability concerns. Buried structure with generally well-graded embankments.

Brook Robazza, Jesse Gallop
Inspector(s) (please type or print)


Signature(s)

Brook Robazza
Professional Engineer (EoR) (please type or print)


Signature(s)

STRUCTURE ID: 113 – CHIPPENDALE ROAD CULVERT AT MCDONALD CREEK WEST **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream

003. North Inlet

004. South Outlet

005. East Approach

006. West Approach

STRUCTURE ID: 113 – CHIPPENDALE ROAD CULVERT AT MCDONALD CREEK WEST **DATE:** 09/05/2022

GENERAL ARRANGEMENT

011. Bridge Deck

012. Culvert Interior (Note Obstructed Baffles)

CONFIGURATION

013. Splice Bolt Orientation, Typ.

014. North Railing, Typ.

015. Stormwater Outfall West of Culvert Inlet

016. Stormwater Drainpipe East of Culvert Inlet

STRUCTURE ID: 113 – CHIPPENDALE ROAD CULVERT AT MCDONALD CREEK WEST **DATE:** 09/05/2022

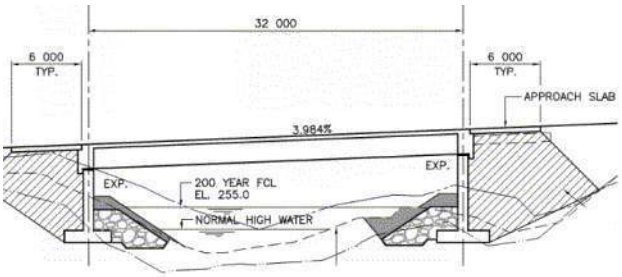
NOTABLE DEFICIENCIES

013. Obstructed Bulkheads, Typ.

014. Missing Splice Bolts at Inlet

STRUCTURE ID: 115 – CHIPPENDALE ROAD OVER ROGERS CREEK **DATE:** 09/07/2022

DESCRIPTION



CONSTRUCTION DATE:	2010	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Chippendale Road	
FEATURE CROSSED:	Rogers Creek	
SUBSTRUCTURE:	Abutments – semi-integral reinforced concrete spread footings with MSE wingwalls	
SUPERSTRUCTURE:	Prestressed concrete I-girders, Composite with a cast-in-place concrete deck	
WEARING SURFACE:	Asphalt	
APPROACHES:	Asphalt roadway in a straight-alignment with bridge	
GENERAL:	SPANS:	1-span
	TOTAL LENGTH:	32.0m
	DECK AREA:	82m^2
	BEARINGS:	Elastomeric Bearing
	BANK/PIER PROTECTION	None
	GUARDRAIL:	Steel
	CURB:	Concrete
	UTILITIES:	Gas; Watermain
	CLEARANCE:	3m
	ROADWAY CLASS:	Local
	SIGNAGE:	Delineators; Pedestrian Crosswalk; Fish-bearing Stream
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	67 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~15 yr) 2. Bearing Replacement (~15 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Add/Adjust Riprap to Better Protect Embankment Slopes (~$5,000) 2. Add Delineator and Bicyclist Dismount Signs (~$2,000) 3. Add TAC Barrier Flares or Crash Attenuators (~$5,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
115	Chippendale Road over Rodgers Creek	9/7/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

INSPECTION NOTES BY COMPONENT
All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk			75	25				R	Debris buildup could threaten abutment embankments if damming occurs.
2	Channel			100					R	Mild skew to wate flow with bridge significantly overspanning active channel.
3	Erosion Protection		25	50	25				R	Eorsion protection required at both abutments due to inherent loose soil structure.
4	Substructure Scour			100					R	No significant scour present.
	SUBSTRUCTURE									
5	Foundation Movement			100					R	No evidence of foundation movement.
6	Abutments		50	50					R	Generally good-fair condition.
7	Wing/Retaining Walls			95	5					Inadequate application of sealant along wing wall joint.
8	Embankment			75	25				R	Upper portions of slope are unprotected.
9	Footings/Piling			100					R	Exposed portions of footings are in fair condition.
10	Pier Columns/Walls/Cribs							N		
11	Bearings		50	50					R	Minor bulging experienced by half of the bearings.
12	Caps							N		
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		80	15	5				R	Spot locations of exposed reinforcing along soffit of deck parapet.
18	Portals							N		
19	Bracing/Diaphragms							N		
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets							N		
27	Camber/Sag			100					R	No camber issues.
28	Live Load Vibration			100					R	No live load vibration issues.
29	Coating (structure)			100					R	Structure coatings at light standard and railing connections in fair condition.
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		25	75					R	Generally good-fair except at deck joint locations.
32	Deck Joints			75	25				1	Visibile transverse cracking at deck joint of each approach slab. Sealant failure.
33	Curbs/Wheelguards			95	5				R	Curbs in generally fair condition except for minor impact damage.
34	Sidewalk(s)			100					R	Surface corrosion visible at railing base plate connections.
35	Railings/Parapets			100					R	
36	Median Barrier							N		
37	Drains/Pipes			100					R	
38	Coating (Railings)		95	5					R	
	APPROACHES									
39	Signing/Lighting			50	50				R	
40	Roadway Approaches		100						R	
41	Roadway Flares			50	50				R	

Conditions Codes

E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Delineators installed at all four corners. Fish-bearing creek signs on northwest and southeast bridge corners. Cross-walk at West Approach.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Hollyburn Mountain, with sections of steep gradient, but the creek has moderate gradient at the bridge site.

Scour Notes

The bridge significantly overspans the creek and the only small amount of scour present is constrained to the limited riprap along the channel.

The riprap has shifted since the original construction, with much of it appearing to have deposited itself downstream of the bridge.

Rehab Work Notes

Reposition existing riprap or add additional riprap to the embankments and channel edges below the bridge to prevent further scour and

erosion. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional

should be considered to ensure bridge user safety. Considering the heavy bicycle usage on the bridge, bicycle dismount signs or railings

meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Maintenance Work Notes

Add delineator and bicycle dismount signs. Monitor deck joints in asphalt for further deterioration.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with no major areas of concern.

Additional Utility Concern Notes

Watermain and connections in relatively good condition.

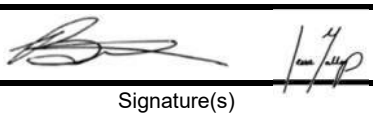
Additional Urgency Rating Notes

Overall the structure is in generally good condition, with the only area of concern being potential future erosion to the channel edges and embankments. The structure is expected to have low vulnerability to seismic demands.

Seismic Vulnerability Notes

The single-span structure is expected to have low vulnerability to seismic demands.

Brook Robazza, Jesse Gallop
Inspector(s) (please type or print)


Signature(s)

Brook Robazza
Professional Engineer (EoR) (please type or print)


Signature(s)

STRUCTURE ID: 115 – CHIPPENDALE ROAD OVER RODGERS CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

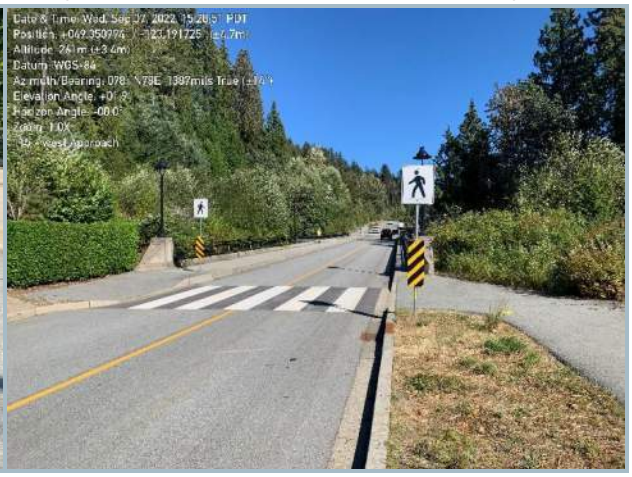
001. Upstream

002. Downstream

003. North Elevation

004. South Elevation
(Note: Downstream Debris in Creek Bed)

005. East Approach



006. West Approach

STRUCTURE ID: 115 – CHIPPENDALE ROAD OVER RODGERS CREEK **DATE:** 09/07/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. Bridge Deck

010. Bridge Soffit

STRUCTURE ID: 115 – CHIPPENDALE ROAD OVER RODGERS CREEK **DATE:** 09/07/2022

CONFIGURATION

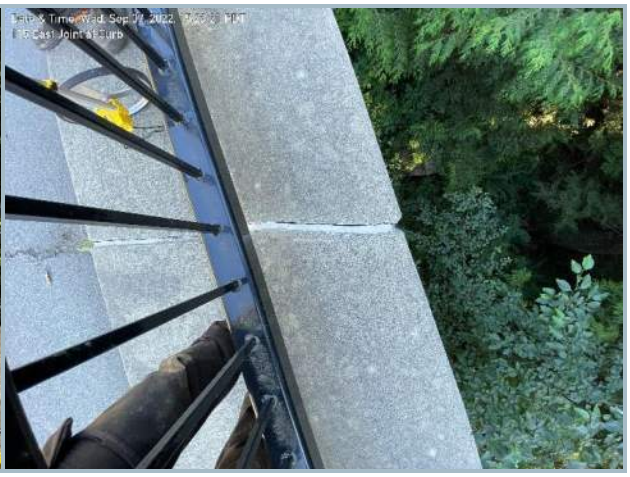
011. Wingwall Configuration with Fiberboard Joint Filler, Typ.

012. Profile of South Wingwall at West Abutment

013. Interior Waterman Utility

014. Utility Line Along North Profile

015. Sidewalk Along North Profile



016. East Joint at Curb, Typ.

STRUCTURE ID: 115 – CHIPPENDALE ROAD OVER RODGERS CREEK **DATE:** 09/07/2022

SEISMIC FORCE REISISTING SYSTEM

017. South Girder Shear Key at West Abutment

018. North Girder Shear Key at East Abutment

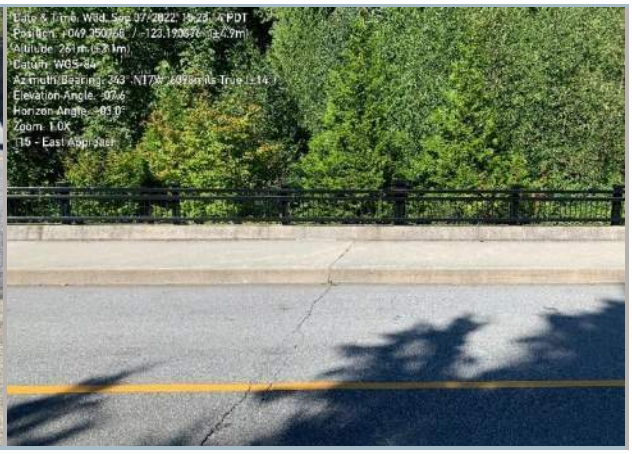
019. Midspan Lateral Bracing Members, Typ.

020. Elastomeric Bearing Pad in Moderate Condition, Typ.

STRUCTURE ID: 115 – CHIPPENDALE ROAD OVER RODGERS CREEK **DATE:** 09/07/2022

NOTABLE DEFICIENCIES

021. Cracking of Asphalt Wearing Surface at West Approach (Note Skewed Orientation)



022. Cracking of Asphalt Wearing Surface at East Approach (Note Skewed Orientation)

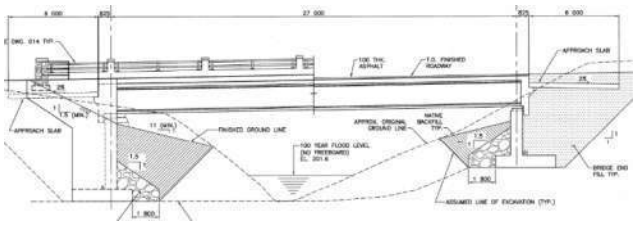
023. Scour Accumulation on West Embankment

024. Debris Accumulation on East Embankment

025. Extensive Brush and Vegetation, Typ.

STRUCTURE ID: 116 – BURFIELD PLACE OVER PIPE CREEK **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	2014	
BRIDGE ORIENTATION:	East-West	
FEATURE SUPPORTED:	Single lane for Chippendale Road	
FEATURE CROSSED:	Pipe Creek	
SUBSTRUCTURE:	Abutments - Reinforced concrete on spread footings with MSE wall	
SUPERSTRUCTURE:	3 - Prestressed concrete I-girders, Composite with a precast concrete deck	
WEARING SURFACE:	Asphalt	
APPROACHES:	Asphalt roadway in straight-alignment with bridge	
GENERAL:	SPANS:	1-span: 27.0m
	TOTAL LENGTH:	27.0m
	DECK AREA:	108m^2
	BEARINGS:	Elastomeric Bearing
	BANK/PIER PROTECTION	None
	GUARDRAIL:	Steel
	CURB:	Concrete
	UTILITIES:	Watermain
	CLEARANCE:	9.5m
	ROADWAY CLASS:	Local
	SIGNAGE:	Stop and Yield signs to accommodate single-late traffic
SEISMIC ASSESSMENT:	None	
DIAGNOSTIC TESTING/STUDY:	None	
PAST REHABILITATION WORKS:	None	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	67 yr (based on original construction date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Resurface Bridge Deck and Approaches (~25 yr) 2. Bearing Replacement (~25 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Add/Adjust Riprap to Better Protect Embankment Slopes (~$5,000) 2. Add TAC Barrier Flares or Crash Attenuators (~$12,000) 3. Inject and Seal Abutment, Wing Wall, Parapets Joints/Cracks (~$2,500) 4. Bicyclist Dismount Signs (~$1,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Deck, Sidewalk, Gutters, and Drains (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Steel Railings (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Replace Barriers affected by Vehicle Strikes, As Needed. 6. Tighten Loose Railing Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Bridge (~$1,500; no associated specification). 8. Reseal Asphalt Deck Joints and Parapet/Curb/Sidewalk Joints As-Needed (~$1,500, depending on extent; MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 536 and Cl. 413.32.06b, respectively).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
116	Burfield Place over Pipe Creek	9/5/2022

Enter % in each condition. See BMIS User Manual 15.2.2

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk		100						R	Good clearance over creek.
2	Channel		100						R	Good overspan of creek.
3	Erosion Protection			50	50				1	No significant riprap; however, abutment set backs mitigate this.
4	Substructure Scour		100						R	Abutment setbacks preventing scour.
	SUBSTRUCTURE									
5	Foundation Movement		100						R	No evidence of foundation movement.
6	Abutments		100						R	Integral abutments with loose evazote in gap between the diaphragm and pile caps.
7	Wing/Retaining Walls		100						R	No issues.
8	Embankment			75	25				1	Lack of scour and erosion protection initiating localized embankment failure.
9	Footings/Piling		100						R	Exposed portions of the footings are in good condition.
10	Pier Columns/Walls/Cribs							N		
11	Bearings		50	50					R	Visible bulging between steel laminations.
12	Caps		100						R	No issues.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders	40	50	10					R	All good or very good except for minor hogging cracks at girder ends.
18	Portals							N		
19	Bracing/Diaphragms		100						R	No bracing or diaphragm issues.
20	Truss Chords/Arch Ribs							N		
21	Arch Ties							N		
22	Truss Diagonals							N		
23	Truss Rods/ Verticals							N		
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets							N		
27	Camber/Sag		100						R	No sag issues.
28	Live Load Vibration		100						R	No noticeable LL vibration.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties							N		
31	Wearing Surface		90	10					R	Generally good except for asphalt not being poured flush with gutters.
32	Deck Joints		25	50	25				R	No joints in deck asphalt, but present in sidewalks.
33	Curbs/Wheelguards		90	10					R	Rough joint at transition from gutters to curbs.
34	Sidewalk(s)		80	20					R	No significant issues.
35	Railings/Parapets		80	20					R	
36	Median Barrier							N		
37	Drains/Pipes			100					R	
38	Coating (Railings)		80	20					R	
	APPROACHES									
39	Signing/Lighting		50		50				R	
40	Roadway Approaches		100						R	
41	Roadway Flares			100					R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Yield to Oncoming Traffic sign and One Lane sign on west approach. Stop sign on east approach.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Drainage area extends to Cypress Mountain area, with sections of steep gradient, but the creek has moderate gradient under the bridge.

Scour Notes

No significant scour; however, the original riprap appears to have shifted off the embankments.

Rehab Work Notes

Replacing or repositioning of riprap at embankments is recommended to improve protection of the embankment fills. Inject and seal abutment, wing wall, parapets joints and cracks. Barrier flares or crash attentuators meeting TAC guideline requirements are not present on the bridge approaches and their additional should be considered to ensure bridge user safety. Considering potential bicycle usage on the bridge, bicycle dismount signs or railings meeting the minimum 1.4m height requirements of the BC ATCG should be added to the bridge.

Maintenance Work Notes

Delineator signs are required on all four bridge corners.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Overall, the structure is in good-fair condition with no major concerns.

Additional Utility Concern Notes

Watermain and connections are in good condition.

Additional Urgency Rating Notes

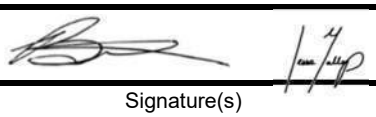
Overall, no significant structural issues require attention, although some non-structural maintenance items are present.

Seismic Vulnerability Notes

Relatively new structure that is expected to perform well under seismic loading.

Brook Robazza, Jesse Gallop

Inspector(s) (please type or print)



Signature(s)

Brook Robazza

Professional Engineer (EoR) (please type or print)

Signature(s)

STRUCTURE ID: 116 – BURFIELD PLACE OVER PIPE CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. Upstream

002. Downstream (Note Extensive Vegetation Growth and Poor Slope Stability)

003. North Elevation

004. South Elevation

005. East Approach

006. West Approach

STRUCTURE ID: 116 – BURFIELD PLACE OVER PIPE CREEK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

007. East Abutment

008. West Abutment

009. Bridge Deck

010. Bridge Soffit (Note Precast Deck Panels)

011. Bridge Soffit Along North Profile

STRUCTURE ID: 116 – BURFIELD PLACE OVER PIPE CREEK **DATE:** 09/05/2022

CONFIGURATION

012. Watermain Utility Along North Profile

013. Wingwall at West Abutment

014. Non-continuous Joint Application for Approach Slab

SEISIMIC FORCE REISISTING SYSTEM

015. Shear Key at Abutment

016. Transverse Lateral Restraint along Backwall

STRUCTURE ID: 116 – BURFIELD PLACE OVER PIPE CREEK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES

017. Cracking of Asphalt Wearing Surface Along Approach Slab, Typ.

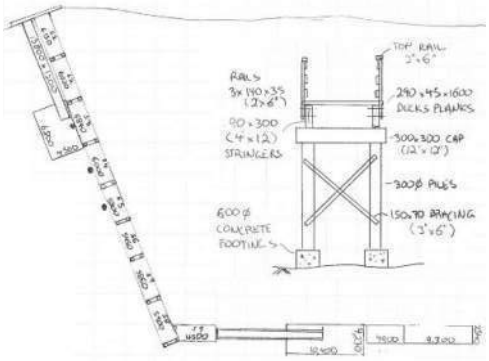
018. Moisture Ingress at Soffit Below Cracked Asphalt of Approach Slab

019. Expansion Joint Peel at Northeast Section of Sidewalk

020. Minor Cracking & Efflorescence along Top Flange of Central Girder at West Abutment

STRUCTURE ID: 401 – EAGLE HARBOUR MAINLAND PIER **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	Unknown	
PIER ORIENTATION:	East-West	
FEATURE SUPPORTED:	Eagle Harbour mainland access	
FEATURE CROSSED:	Eagle Harbour	
SUBSTRUCTURE:	Abutments – concrete abutment at East end connected to aluminum gangway and mainland pier float at West end supported by timber piles with concrete footings (at rock-supported pier)	
SUPERSTRUCTURE:	Timber stringers supporting a timber decking with an aluminum truss gangway (replaced in 2015) to a floating timber dock.	
WEARING SURFACE:	Expanded metal mesh over timber decking on inclined surfaces and docks	
APPROACHES:	Bridge connects with entrance to/from Eagle Harbour Rd. on the East end	
GENERAL:	TOTAL LENGTH:	Mainland pier - 9-span timber pier = 51m long, floating dock = 24.6m long
	DECK AREA:	162m^2
	BEARINGS:	Steel
	BANK/PIER PROTECTION	None
	GUARDRAIL:	timber
	CURB:	Timber bottom railing
	UTILITIES	Power for the lighting along railing on mainland pier.
	CLEARANCE:	4m
	ROADWAY CLASS:	Local
	SIGNAGE:	Eagle Island resident use only; use at own risk.
SEISMIC ASSESSMENT:	None	
DIAGONISTIC TESTING/STUDY:	1994: Watermain and hangers relocated 1996: Pier 1 foundation footing scour repaired 2007: Deck strengthening – installation of transverse steel beams 2013: Focused pier inspection report	
PAST REHABILITATION WORKS:	2002: Column strengthening to Pier 1 (West) and Pier 2 (East) 2015: Major rehabilitation works	

OVERALL CONDITION:	Fair-Poor Condition – Urgency Rating = 3
ESTIMATED REMAINING SERVICE LIFE:	15 yr (based on major rehabilitation completion date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Shim Bearing Seats Above Each Pier (~5 yr) 2. Re-deck Float (~10 yr) 3. Re-deck Pier (~15 yr) 4. Bearing Replacement (~25 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Re-deck Float Deck Adjacent to Ramp and Add Pile Slider (~$7,500) 2. Reapply Blackout Paint for Deck Lighting (~$1,000) 3. Reposition or Replace Bearing Pins at Aluminum Ramp (~$2,000) 4. Realign Pier 4 Footing and Cap (~$20,000) 5. Replace Pier Bracing at All Piers and Grout All Pier Pedestals (~$15,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Pier and Float Decks (~$2,000; no associated specification). 3. Clean Debris from Bearing Areas (~$2,000; no associated specification). 4. Touch-Up Coating of Galvanized Components (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Float Edges due to Boat Strikes, As Needed. 6. Tighten Loose Connection Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Pier and Float (~$1,500; no associated specification).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	Structure Name	Inspection Date (yyyy/mm/dd)
401	Eagle Island Docks: Mainland Dock	9/5/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.
	HYDROTECHNICAL									
1	Debris Risk			100					R	Estuary with potential for drift wood accumulation around piers.
2	Channel							N		No channel.
3	Erosion Protection	20				80			R	Most piers unprotected; however, two at the end of the pier are on bedrock.
4	Substructure Scour			80	20				R	A couple of pier foundations have become exposed but most remain covered.
	SUBSTRUCTURE									
5	Foundation Movement		20	50	20	10			1	Most piers have rotated to some degree, but Pier 4 has rotated 4 degrees.
6	Abutments		30	50	20				1	Some cracks and voids present but do not appear to be propagating.
7	Wing/Retaining Walls		40	50	10				1	Adjoining walls in generally good condition except for moderate cracking.
8	Embankment		100						R	No issues with land embankment.
9	Footings/Piling		50	50					R	Piles generally good fair, but tops cut out of plumb on some and others have rot.
10	Pier Columns/Walls/Cribs			80	10	10			R	Pile pedestals at Piers 8 and 9 have significant vertical cracks.
11	Bearings			50	50				R	Direct bearing of girders on caps.
12	Caps			80	20				1	Most creasote caps not fully bearing on piles.
13	Corbels							N		
14	Dolphins/Fenders		50	50					R	Anchor piles for float in good-fair condition.
	SUPERSTRUCTURE									
15	Floor Beams/Transoms							N		
16	Stringers							N		
17	Girders		50	35	15				R	Creosote 4x12s in good-fair condition with longitudinal cracks some members.
18	Portals							N		
19	Bracing/Diaphragms		50	15	30	5			3	Aluminum members in good condition. Timber bracing fair to poor.
20	Truss Chords/Arch Ribs		100						R	Aluminum members in good condition.
21	Arch Ties							N		
22	Truss Diagonals		100						R	Aluminum members in good condition.
23	Truss Rods/ Verticals		90			10			R	Aluminum members in good condition. Most timber posts are cracked.
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets	50	20	20	5	5			2	Fasteners on pier generally good. Joint pins on float and ramp are good to poor.
27	Camber/Sag			90	10				3	Significant sag on float near north edge of ramp.
28	Live Load Vibration		100						R	Short span lengths with little live load vibration.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties		30	50	10				3	Mostly good condition aside from surface wearing and centre ramp panel.
31	Wearing Surface	50		40	5	5			3	Float planks good to very poor. Severe deflection in middle tread of ramp.
32	Deck Joints			70	30				R	Deck panel joints on ramps heavily deformed, replacement/strengthening required.
33	Curbs/Wheelguards		15		85				3	No kick plates except on the aluminum ramp.
34	Sidewalk(s)							N		
35	Railings/Parapets		40	50	10				R	
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)							N		
	APPROACHES									
39	Signing/Lighting		15	85					R	
40	Roadway Approaches			100					R	
41	Roadway Flares		100						R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

3

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Underwater cable utility sign and sign designating use only for Eagle Island residents.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Protected harbour affected by tidal water level fluctuations. Low levels of logging debris, but the pier lies at the entrance to a large marina.

Scour Notes

Most pier foundations are supported by exposed loose sand/mud/silt substrate except at the southernmost piers, which lie on bedrock. The foundationson the loose soils are partially scoured around most their respective perimeters. The abutment is supported by a masonry wall which has been subjected to minor scour at its base.

Rehab Work Notes

Pier 4 is rotated approximately 4 degrees and should be straightened to plumb. Large portions of float, particularly on north side of ramp on the float section closest to the pier has suffered from moderate to severe decay and should be redecked within 4 years. Regrout pile bars on piers 8 and 9, which are founded on the bedrock outcrop at the southern end of the pier. Almost all of the pier cross-bracing members require replacement within 4 years. Replace pile sliders/rub rails that have detached on floats. While likely not needed at this time, erosion protection to the piers not founded on bedrock is recommended in the future to mitigate the high erosion potential of those piers.

Maintenance Work Notes

Pier caps require straightening from their currently rotated orientation. Replace rub rails on pile connections. Tigthen loose connection on ramp joint leading down to float or replace the bearing pin. Monitor splitting on hand rails and mid rails. Monitor longitudinal crack in Span 1 of west girder. Blackout paint on deck lights needs to be reapplied.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

Main Dock: 1.6m x 51m deck, 1.82m out-to-out, 1.05m railing height, 2x12 x 1.6m long planks + 2x6 mid rails, 4x4 x 53.5"@79.5" post spacing.

Aluminum Ramp: 20m long x 47.5" wide with 48" posts. 2x6 running planks, 3 on each side of a centre bay with aluminum tread that is heavily deformed, with a width of 12" and depth of 1".

14.4m long x 2.4m wide pier float. 9.7m long x 4.4m ramp float.

9.5' max clearance, 7ft min clearance (not including bedrock piers).

19' pier spacing.

Overall, the structure is heavily aged, with the superstructure of the pier in overall fair condition, whereas the substructure is in a general fair-poor condition.

Given the current condition, there are no immediate safety concerns with the structure. Most of the pier footings appear to have high erosion potential; however, given the site conditions and past performance, urgent action is likely not needed at this time.

Additional Utility Concern Notes

Power cables to deck lights are aging and may require refurbishment to ensure reliable function.

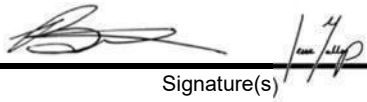
Additional Urgency Rating Notes

While the structure is likely vulnerable to seismic loading, gravity load-carrying capacity is not signficantly reduced. Moderate urgency of repairs are required to reduce further decay of float decking, wear on the ramp connection, and ensure adequate performance of the piers in a seismic event.

The greatest risk to the structure is likely from boat or large driftwood impact to the piers in a storm scenario.

Seismic Vulnerability Notes

The cross-bracing on the piers is in poor condition and almost completely failed on some piers. The seismic demands are likely low due to the low seismic mass (the structure is entirely timber or aluminum), but the structure does not have a reliable seismic force resisting system, and therefore is likely moderately vulnerable to seismic loading.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

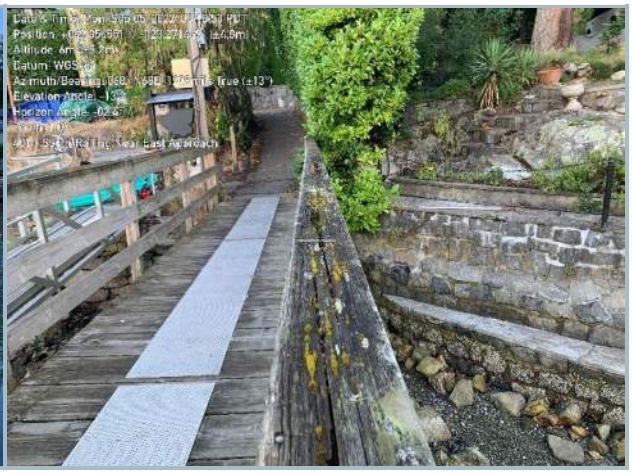
001. Upstream

002. Downstream

003. North Elevation

004. South Elevation

005. East Approach

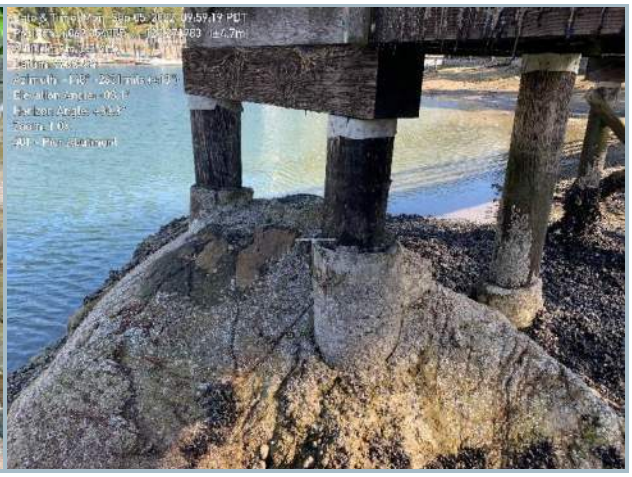


006. West Approach
(Note: Splitting and Warping of Top-rail)

STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

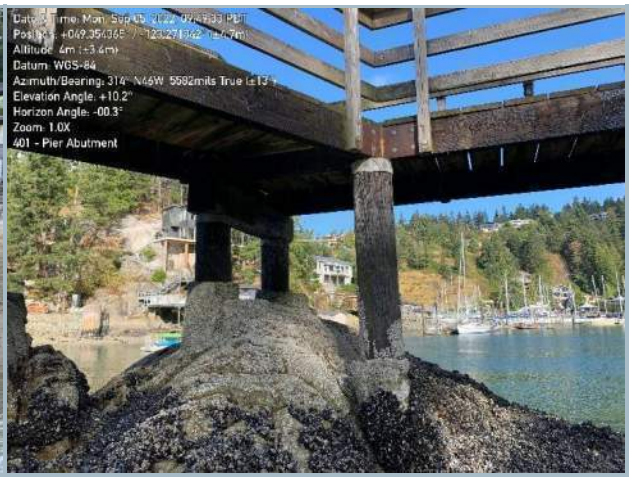
GENERAL ARRANGEMENT

007. East Abutment

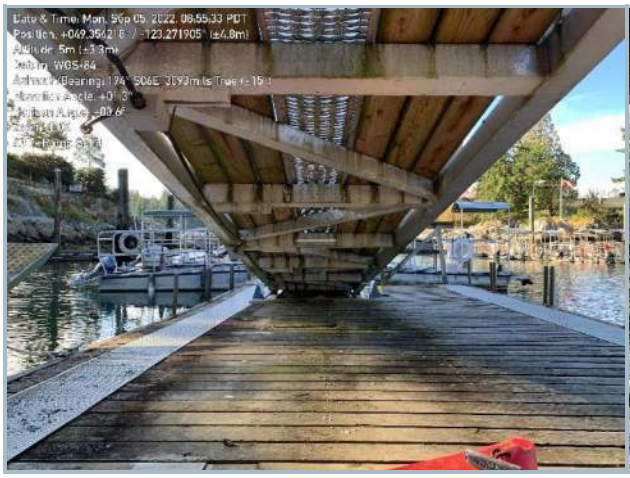


008. West Pier Abutment on Concrete Pedestal and Bedrock

009. Braced Timber Piers, Typ.



010. West Pier Abutment on Bedrock



011. Aluminum Gangway Soffit Viewing South

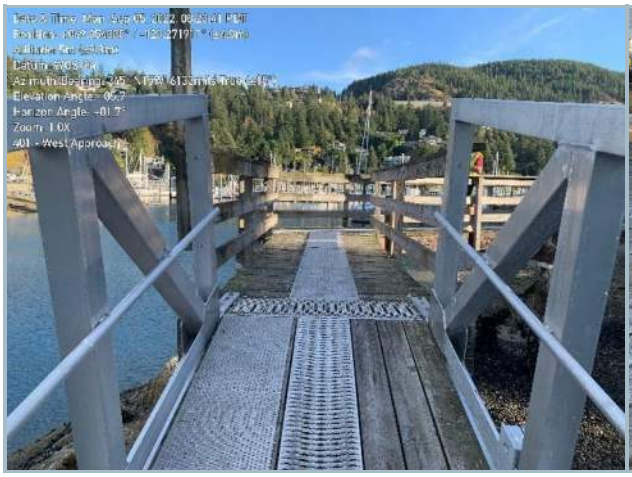
012. Timber Pier Soffit

STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

CONFIGURATION

013. Timber Railing, Typ.

014. Aluminum Gangway Truss Rail, Typ.



015. Gangway Access Approach to Timber Pier (Note: Skewed Corner Orientation)

016. Gangway Slider Connection Mechanism

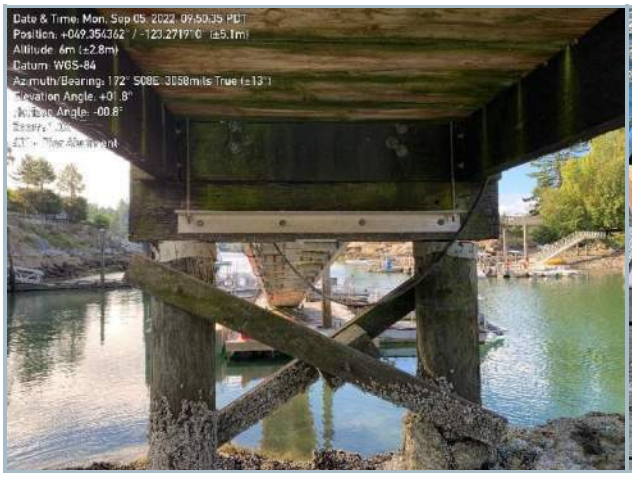
017. Extended Gangway Connection

STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

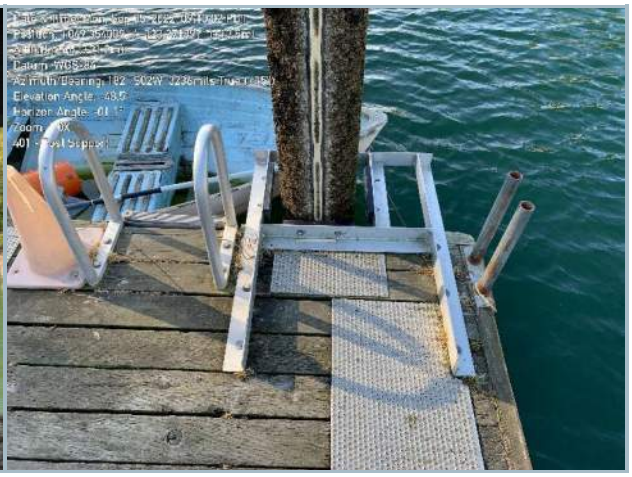
SEISMIC FORCE REISISTING SYSTEM

018. Timber Girder Splice Connection

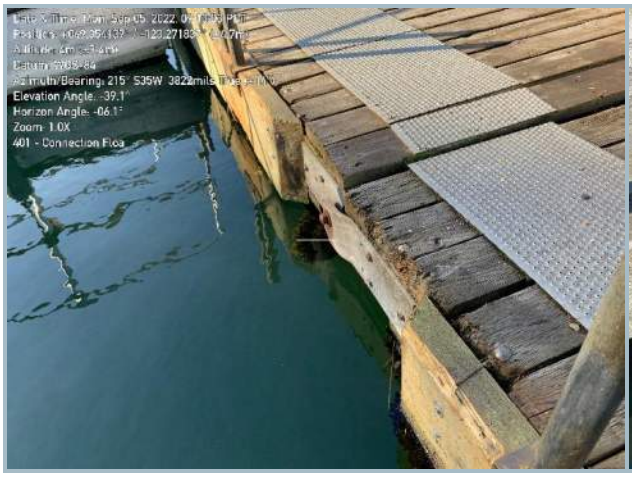
019. Interior Bolted Angle Connection



020. Gangway Access Platform to Timber Pier Connection



021. Timber Pile Dock Restraint Connection, Typ.

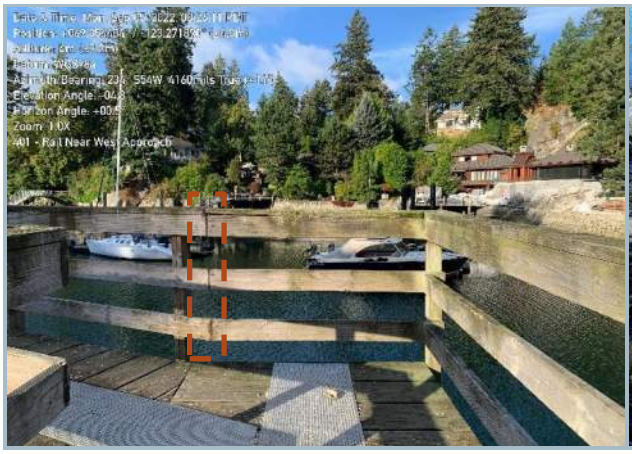


022. Anchored Plate Dock Connection

023. Anchored Bracket Dock Connection

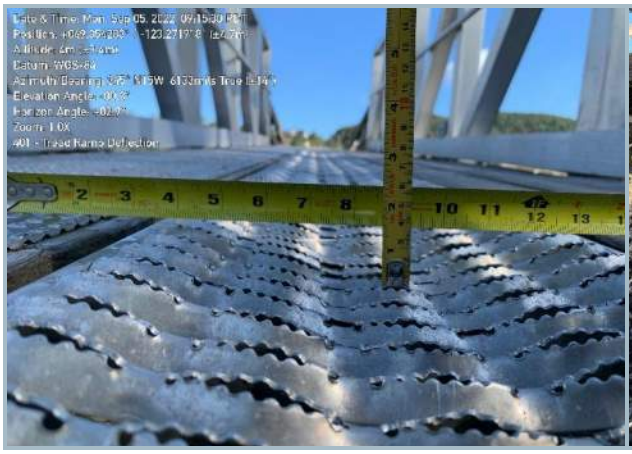
STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES



024. Vertically Unsupported Timber Splice at Bedrock Pier

025. Cracked Concrete Pedestal at Bedrock Pier



026. 1.5" Deflection of Unsupported Central Walkway Tread

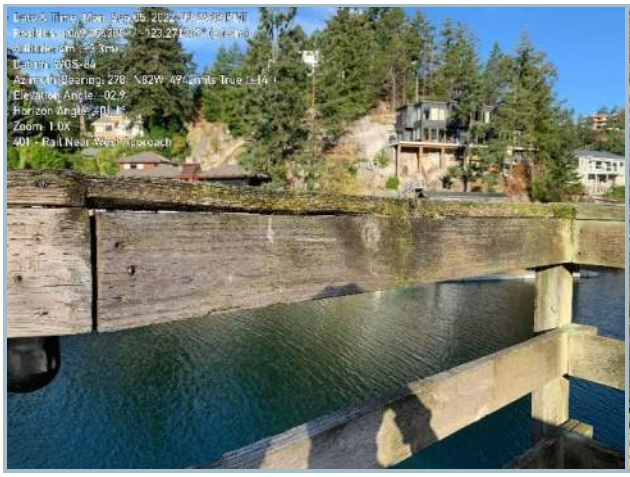
027. Decaying Timber Brace at Pier, Typ.

028. Non-bearing Pier Cap at Gangway Transition

029. Diminishing Black Paint on Light Fixtures, Typ.

STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES



030. Localized Lifting of Decaying Top-rail, Typ.

031. Unsecure Mid-rail at Pier Abutment

032. Timber Pier Dock Restraint Missing Teflon Bumper

033. Decay Deck Members at East Profile of Dock

034. Dissimilar Timber Pile Restraint

035. Overlapping Plates at Dock Connection

STRUCTURE ID: 401 – MAINLAND DOCK **DATE:** 09/05/2022

NOTABLE DEFICIENCIES

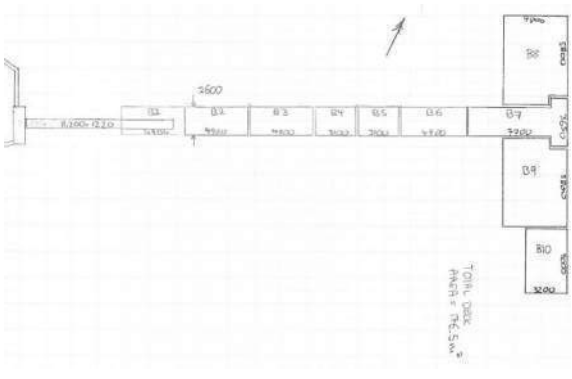
036. Unbalanced Longitudinal Beam Bearing Seat

037. Full Longitudinal Splitting of Timber Splice

038. Inadequate Placement of Anchors at Bedrock Pier

STRUCTURE ID: 402 – EAGLE ISLAND PIER **DATE:** 09/05/2022

DESCRIPTION



CONSTRUCTION DATE:	Unknown	
PIER ORIENTATION:	East-West	
FEATURE SUPPORTED:	Eagle Island access	
FEATURE CROSSED:	Eagle Harbour	
SUBSTRUCTURE:	Abutments – concrete abutment at West end leading to float on East end supported by timber piles	
SUPERSTRUCTURE:	Single span aluminum truss and aluminum gangway spanning to a series of floating timber docks	
WEARING SURFACE:	Expanded metal mesh over timber decking on inclined surfaces and docks	
APPROACHES:	Bridge connects with entrance to from Eagle Harbour Rd. on the East end	
GENERAL:	TOTAL LENGTH:	33.5m
	DECK AREA:	163.8m^2
	BEARINGS:	Elastomer
	BANK/PIER PROTECTION	None
	GUARDRAIL:	Timber
	CURB:	Timber bottom railing
	UTILITIES	Charging station
	CLEARANCE:	4m
	ROADWAY CLASS:	Local
	SIGNAGE:	Eagle Island resident use only; use at own risk.
SEISMIC ASSESSMENT:	None	
DIAGONISTIC TESTING/STUDY:	2013: Focused pier inspection report	
PAST REHABILITATION WORKS:	2015: Major Rehabilitation Works	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	15 yr (based on major rehabilitation completion date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Shim Bearing Seats Above the Pier (~10 yr) 2. Re-deck Float (~15 yr) 3. Re-deck Pier (~20 yr) 4. Bearing Replacement (~25 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Remove Excess Corrosion at Piles and Coat or Add Anodes (~$2,500) 2. Perform Localized Redecking on Float (~$2,500) 3. Repair Pile Sliders at (2) Locations (~$1,500)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Pier and Float Decks (~$1,500; no associated specification). 3. Clean Debris from Bearing Areas (~$1,000; no associated specification). 4. Touch-Up Coating of Galvanized Components (~$1,000; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Float Edges due to Boat Strikes, As Needed. 6. Tighten Loose Connection Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Pier and Float (~$1,000; no associated specification).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	402	Structure Name	Eagle Island Docks: Island Dock	Inspection Date (yyyy/mm/dd)	9/5/2022

	COMPONENT	PERCENT CONDITION RATING (Enter % in each condition. See BMIS User Manual 15.2.2) E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT (All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.)
	HYDROTECHNICAL									
1	Debris Risk			100					R	Estuary with potential for drift wood accumulation around piers.
2	Channel							N		No channel.
3	Erosion Protection	20				80			R	Abutment is lightly riprapped, but to an adequate degree.
4	Substructure Scour			80	20				R	Anchor brackets on land side have exposed anchors.
	SUBSTRUCTURE									
5	Foundation Movement			100					R	No evidence of significant foundation movement.
6	Abutments			90	10				1	Abutment shelf has visible signs of debris accumulation on concrete from deck.
7	Wing/Retaining Walls			100					R	Riprap abutmented with only small wing walls.
8	Embankment			85	15				1	Embankment is steep but is relatively well riprapped.
9	Footings/Piling		75	20	5				2	Up to 1mm corrosion on pile surfaces.
10	Pier Columns/Walls/Cribs		75	20	5				2	Piles act as pier columns, with up to 1mm corrosion on the pile surfaces.
11	Bearings		40	60					1	Deformation visibile on bearing pad.
12	Caps		65	30	5				1	Steel channel section showing signs of deteoriation and surface corrosion.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms		50	50					R	Aluminum floorbeams in generally good condition.
16	Stringers							N		
17	Girders		20	75	5				R	Longitudinal girder members in generally good-fair condition.
18	Portals							N		
19	Bracing/Diaphragms		50	50					R	Aluminum vierendeel bracing in generally good condition.
20	Truss Chords/Arch Ribs		50	50					R	Aluminum truss chords in good condition.
21	Arch Ties							N		
22	Truss Diagonals		70	30					1	Connections have significant debris buildup.
23	Truss Rods/ Verticals		70	30					R	Aluminum truss verticals/posts in good condition.
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		40	60					R	Pin connections in generally condition.
27	Camber/Sag			100					R	No sag issues.
28	Live Load Vibration			100					R	Live load vibration as expected for aluminum ramp.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties		60	40					R	Moisture accumulation from water entering through gaps in adjoing deck sections.
31	Wearing Surface		70	30					R	Visible signs of moisture accumulation on wearing surfface from deck soffit.
32	Deck Joints		10	90					1	No visible signs of deterioation at hinge location between adjacent ramps.
33	Curbs/Wheelguards		40	60					R	Aluminum kick plates in generally good condition.
34	Sidewalk(s)							N		
35	Railings/Parapets		40	60					R	
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)							N		
	APPROACHES									
39	Signing/Lighting			100					R	
40	Roadway Approaches			100					R	
41	Roadway Flares			100					R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating

2

For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

No other posted hazard signs.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Protected harbour affected by tidal water level fluctuations. Low levels of logging debris, but the pier lies at the entrance to a large marina.

Scour Notes

The pier foundations are all steel piles except for the abutment, and none are significantly affected by scour.

Rehab Work Notes

Remove excess corrosion on piles supporting pier and coat with an approved product or add anodes to inhibit further corrosion.

Maintenance Work Notes

Repair pile sliders/rub rails in two locations. Replace localized decking planks on float that are exhibiting above-average decay.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

21 x 5m float with 2x5 cut out of southeast corner.

2.7x11.3m East Float Section

5x6m West Float Section

15.2x9.4m x 1.2 ramp

Consider installing protective screen on railings to minimize accessible gap between railing members.

Overall condition is good-fair, with the primary area of concern being the relatively high level of corrosion present on the piles on the pier closest to the abutment.

Additional Utility Concern Notes

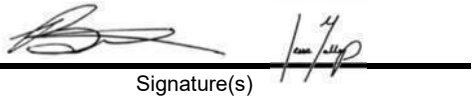
Electrical utility attached to deck soffit, but no immediate concern.

Additional Urgency Rating Notes

Only minor repairs are required at this time, none of which have significant effect on the load-carrying capacity of the structure.

Seismic Vulnerability Notes

The superstructure is lightweight, being composed almost entirely of aluminum and timber members, and with relatively robust piled foundations, the structure is considered to have low vulnerability to seismic loading.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 402 – EAGLE ISLAND PIER **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. North Elevation

002. South Elevation

003. West Approach (Access from Eagle Island Trail)

004. East Approach (Access from Landing Dock)

005. West Abutment

006. Steel Pile West Pier

STRUCTURE ID: 402 – EAGLE ISLAND PIER **DATE:** 05/09/2022

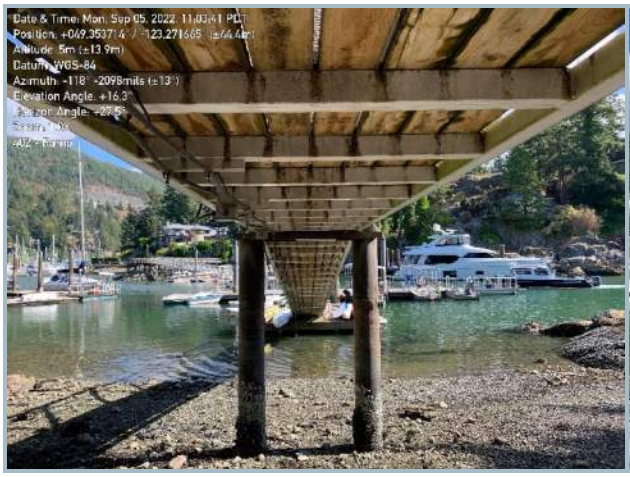
GENERAL ARRANGEMENT

007. Southwest Abutment Wingwall

008. Aluminum Gangway Deck Tread

009. Deck of East Intermediate Landing Dock

010. Deck of East Landing Dock



011. West Segment Gangway Soffit

012. East Segment Gangway Soffit

STRUCTURE ID: 402 – EAGLE ISLAND PIER **DATE:** 09/05/2022

CONFIGURATION

013. Exterior Dock-Timber Pile Restraint Connection, Typ.

014. Electrical Utility Along North Profile of Deck Soffit

SEISIMIC FORCE REISISTING SYSTEM

015. Shear Key at Abutment

016. Anchored Pier Connection with Elastomer Bearing

017. Timber Pile Dock Restraint System, Typ. (Note: Missing Roller Support)

STRUCTURE ID: 402 – EAGLE ISLAND PIER **DATE:** 09/05/2022

NOTABLE DEFICIENCES

018. Minor Surface Corrosion of Pier Cap

019. Minor Undermining at Northwest Section of West Backwall

STRUCTURE ID: 403 – EAGLE HARBOUR MAINLAND SERVICE FLOAT **DATE:** 09/05/2022

DESCRIPTION

CONSTRUCTION DATE:	Unknown	
PIER ORIENTATION:	North-South	
FEATURE SUPPORTED:	Eagle island access	
FEATURE CROSSED:	Eagle Harbour	
SUBSTRUCTURE:	Abutments – stone abutment at East end leading to float on East end supported by timber piles	
SUPERSTRUCTURE:	Single span aluminum truss gangway spanning to a service floating timber dock supported by anchored by timber connections and timber piles	
WEARING SURFACE:	Expanded metal mesh over timber decking on inclined surfaces and docks	
APPROACHES:	Bridge connects with entrance to from Eagle Harbour Rd. on the East end	
GENERAL:	TOTAL LENGTH:	N/A
	DECK AREA:	6.8 m long x 4.5 m = 30.6 m^2
	BEARINGS:	None
	BANK/PIER PROTECTION	None
	GUARDRAIL:	Timber
	CURB:	Timber bottom railing
	UTILITIES	Charging station
	CLEARANCE:	N/A
	ROADWAY CLASS:	Local
	SIGNAGE:	Eagle Island resident use only; use at own risk.
SEISMIC ASSESSMENT:	None	
DIAGONISTIC TESTING/STUDY:	2013: Focused pier inspection report	
PAST REHABILITATION WORKS:	2015: Major rehabilitation works	

OVERALL CONDITION:	Good-Fair Condition – Urgency Rating = 2
ESTIMATED REMAINING SERVICE LIFE:	15 yr (based on major rehabilitation completion date and inspection findings)
RECOMMENDED UPGRADE LIFE CYCLE TIMELINE:	1. Re-deck Float (~15 yr) 2. Re-deck Pier (~20 yr) 3. Bearing Replacement (~25 yr)
FIVE-YEAR REMEDIATION AND REHABILITATION PROGRAM:	1. Reposition or Replace Bearing Pins at Aluminum Ramp (~$1,000) 2. Perform Localized Redecking on Float (~$1,000)
RECOMMENDED INSPECTION FREQUENCY:	Monitoring Inspection Frequency: 1 / year Principal Inspection Frequency: 1 / 5 years
ANNUAL ROUTINE MAINTENANCE PROGRAM:	1. Monitoring Inspection (~$500; no associated specification). 2. Clean Pier and Float Decks (~$1,000; no associated specification). 3. Clean Debris from Bearing Areas (~$500; no associated specification). 4. Touch-Up Coating of Galvanized Components (~$500; BC MoTI 2020 Standard Specifications for Highway Construction Volume 1, Cl. 216.12.05a and SS 308 using corresponding BC MoTI Recognized Products List suppliers). 5. Repair or Float Edges due to Boat Strikes, As Needed. 6. Tighten Loose Connection Bolts to Snug-Tight Condition, As Needed. 7. Remove Debris from Channel Under Pier and Float (~$500; no associated specification).

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BRIDGE CONDITION INSPECTION

Inspection Type
☐ Routine ☐ Partial
☑ Detailed

Structure Number	403	Structure Name	Eagle Island Docks: Service Dock	Inspection Date (yyyy/mm/dd)	9/5/2022

PERCENT CONDITION RATING
Enter % in each condition.
See BMIS User Manual 15.2.2

INSPECTION NOTES BY COMPONENT
All poor or very poor conditions should be explained with notes and documented by photos. Label explanation(s) with component numbers.

	COMPONENT	E	G	F	P	V	X	N	CU	INSPECTION NOTES BY COMPONENT
	HYDROTECHNICAL									
1	Debris Risk			100					R	Estuary with potential for drift wood accumulation around piers.
2	Channel							N		No channel.
3	Erosion Protection			80	20				R	Abutment is lightly riprapped, but to an adequate degree.
4	Substructure Scour			80	20				R	Anchor brackets on land side have exposed anchors.
	SUBSTRUCTURE									
5	Foundation Movement			100					R	No evidence of significant foundation movement.
6	Abutments		30	50	20				1	Some cracks and voids present but do not appear to be propagating.
7	Wing/Retaining Walls		40	50	10				1	Adjoining walls in generally good condition except for moderate cracking.
8	Embankment		100						R	No issues with land embankment.
9	Footings/Piling			75	25				2	Pile footings generally good, but timber bracket footings beginning to deteriorate.
10	Pier Columns/Walls/Cribs							N		
11	Bearings			75	25				R	Directly pin-connected to abutment. Pin bolts require tightening.
12	Caps			100					R	No significant issues.
13	Corbels							N		
14	Dolphins/Fenders							N		
	SUPERSTRUCTURE									
15	Floor Beams/Transoms		25	75					R	Floor beams on float are in good-fair condition overall.
16	Stringers							N		
17	Girders								R	Float girders in generally good condition.
18	Portals							N		
19	Bracing/Diaphragms		50	50					R	Aluminum vierendeel bracing in generally good condition.
20	Truss Chords/Arch Ribs		50	50					R	Aluminum truss chords in good condition.
21	Arch Ties							N		
22	Truss Diagonals		70	30					R	Connections on ramp have significant debris buildup.
23	Truss Rods/ Verticals		70	30					R	Connections have significant debris buildup.
24	Cables							N		
25	Panels							N		
26	Pins/Bolts/Rivets		20	70	10				3	Pin connections in generally good condition but require tightening.
27	Camber/Sag			100					R	No sag issues.
28	Live Load Vibration			100					R	Live load vibration as expected for aluminum ramp.
29	Coating (structure)							N		
	DECK									
30	Sub Deck/Cross Ties		30	50	10				3	Mostly good condition aside from surface wearing and centre ramp panel.
31	Wearing Surface		5	60	30	5			3	Float planks good to very poor. Severe deflection in middle tread of ramp.
32	Deck Joints			70	30				R	Deck panel joints on ramps heavily deformed, replacement/strengthening required.
33	Curbs/Wheelguards		40	60					R	Aluminum kick plates in generally good condition.
34	Sidewalk(s)							N		
35	Railings/Parapets		40	60					R	
36	Median Barrier							N		
37	Drains/Pipes							N		
38	Coating (Railings)							N		
	APPROACHES									
39	Signing/Lighting			100					R	
40	Roadway Approaches			100					R	
41	Roadway Flares			100					R	

Conditions Codes			
E	Excellent	V	Very Poor
G	Good	X	Not Inspected
F	Fair	N	Not Applicable
P	Poor		

For Condition Guidelines see BMIS User Manual 15.2.2.

Urgency Rating
2
For definition see BMIS User Manual 15.2.8
"4" and "5" rating must be explained.

Brook Robazza PhD, PEng, PE, Jesse Gallop MEng, EIT
Inspector(s) (please type or print)

Signature

Posted Weight Restriction *(print actual message on sign(s))*

No posted weight restrictions.

Other Posted Hazard Warning Signs

Underwater cable utility sign and sign designating use only for Eagle Island residents.

Drainage Area Description *(water level fluctuation, logging debris, etc.)*

Protected harbour affected by tidal water level fluctuations. Low levels of logging debris, but the pier lies at the entrance to a large marina.

Scour Notes

The structure is supported by an abutment supported by a masonry wall which has been subjected to minor scour at its base. A steel pile is the primary anchor point for the float; however, two other shear key style anchorages on the north deck edge are supported by creasote timber foundations that have moderate scour around their perimeter, which is surrounded by sand and mud.

Rehab Work Notes

Replace localized decking planks on float that are exhibiting above-average decay.

Maintenance Work Notes

Reposition or replace bearing pins at aluminum ramp.

Additional Partial Inspection Notes

Only general inspection completed.

Additional General Inspection Notes

15.2 x 1.2m ramp

7.2m x 5m float

The structure is in generally good-fair condition, with the primary of concern being the foundations of the two smaller anchorages on the north deck edge of the float.

Additional Utility Concern Notes

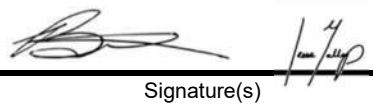
No utility concerns.

Additional Urgency Rating Notes

Only minor repairs are required at this time, none of which have significant effect on the load-carrying capacity of the structure.

Seismic Vulnerability Notes

The superstructure is lightweight, being composed almost entirely of aluminum and timber members, and with relatively robust piled foundations, the structure is considered to have low vulnerability to seismic loading.

Brook Robazza, Jesse Gallop	
Inspector(s) (please type or print)	Signature(s)
Brook Robazza	
Professional Engineer (EoR) (please type or print)	Signature(s)

STRUCTURE ID: 403 – SERVICE DOCK **DATE:** 09/05/2022

GENERAL ARRANGEMENT

001. North Elevation

002. West Elevation
(Note Connection to Timber Pile at Southwest

003. East Approach Gangway Viewing East

004. East Approach Gangway Viewing West

005. East Abutment

006. Dock Soffit

STRUCTURE ID: 403 – SERVICE DOCK **DATE:** 09/05/2022

CONFIGURATION

007. Gangway Railing & Truss Orientation

008. Gangway Connection to East Abutment

SEISMIC FORCE REISISTING SYSTEM

009. Dock Corner Restraint Connection, Typ.

010. Dock Restraint Timber Pier Connection

NOTABLE DEFICIENCIES

011. 2" Deflection of Unsupported Central Walkway Tread

012. Debris Accumulation at Rail Truss Base

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