

To
Alfred Ho, P.Eng., MBA - Asset Management Engineer
**Ministry of Transportation and Infrastructure
(MOTI)**

From
Matt Friderichs, P.Eng., Bridge Engineer Of Record
McElhanney Ltd.

Reviewed
Ernie Wong, P.Eng., Senior Bridge Engineer
McElhanney Ltd.

Re
06880 Canal Road Bridge:
Substructure Renewal Recommendations

Date
November 16, 2020

BACKGROUND

The Canal Road Bridge No. 06880 is located on Canal Road between North Pender Island and South Pender island. The bridge provides single-lane traffic and is the only roadway between the two islands. Typically, the bridge has a roadway width of 3.68 m, except for the east end (South Pender Island side) where the roadway width flares to 7.0 m.



Figure 1 – Existing Bridge Structure

Although there are no specific record drawings available for the bridge, the following summarizes the bridge arrangement and geometry:

- The bridge is assumed to be built circa 1955 and consists of a 90.96m long, 14-span timber trestle structure.
- The main span above the navigation channel (Span 9), consists of steel girders with a span length of approximately 14.15m.



- The other spans (Spans 1 to 8, 10 to 14) have sawn timber stringers with spans varying from 5.8m to 6.4m long.
- During the May 26th, 2017 site inspection with the Ministry Bridge Area Manager, the following reference system was established:
 - First Abutment Position (FAP) is North Pender Island Abutment.
 - Piers are numbered sequentially from FAP with Pier 1 as the first pier reached.
 - Spans are numbered sequentially based on the substructure numbering.
 - It should be noted that in the 2012 WorleyParsons report, the reference system is not consistent as the FAP is the South Pender Island Abutment and is considered Pier 1.

Figure 2 provides the reference system currently used by McElhanney.

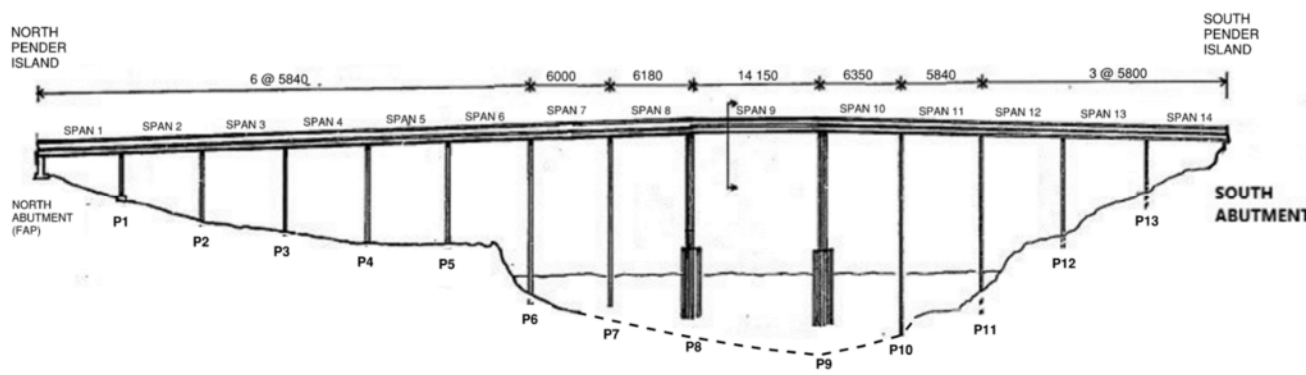


Figure 2 – Structure Elevation

BRIDGE CONDITION

Based on the WorleyParsons Canada Services Ltd., dated March 26, 2012 and the 2015 MOTI BMIS Condition Inspection Report, the following substructure elements have been identified in poor condition and repair / rehabilitation is recommended:

- Pier 10 has 6 piles that require replacement due to marine borer attack, ~75%+ cross section loss
- Pier 8 has 4 piles that require replacement due to marine borer attack, ~75%+ cross section loss
- Piers 7 to 10 all have cross braces that require replacement due to marine borer attack, ~25% to 75% cross section loss.
- A number of Pier 8 piles do not bear or only have partial bearing onto the seabed.
- In general, substructure elements, other than the components identified above, are considered to be in good to fair condition (*ref. MOTI 2015 BMIS report*) with a number of elements identified as having a residual life of 5 more years. (*ref. page 9 WP report*)
- In general, superstructure elements are in good condition.

SUBSTRUCTURE RENEWAL CONCEPTS

Based on discussions with MOTI, McElhanney understands that the scope of the substructure renewal work will consist of extensive rehabilitation to the piles, cross-bracing, and lower pile cap locations at Piers 6 to 11, see **Figure 3**. Based on the extent of identified deterioration, localized replacements of deteriorated members are no longer considered feasible. The retrofit strategy will target complete replacement of the substructure elements for an anticipated repair design life of 20 years.

Other pier locations (North Abutment to Pier 5 and Pier 12 to South Abutment) will have traditional like-for-like future maintenance strategies as access to these areas are not over water and can be easier completed. The rehabilitation of these substructure locations will be confirmed during the initial site visit after confirmation of the substructure renewal strategy for Piers 6 to 11 by MOTI.

It should be noted that the substructure renewal recommendations do not consider any seismic upgrades to the bridge structure, as confirmed by MoTI.

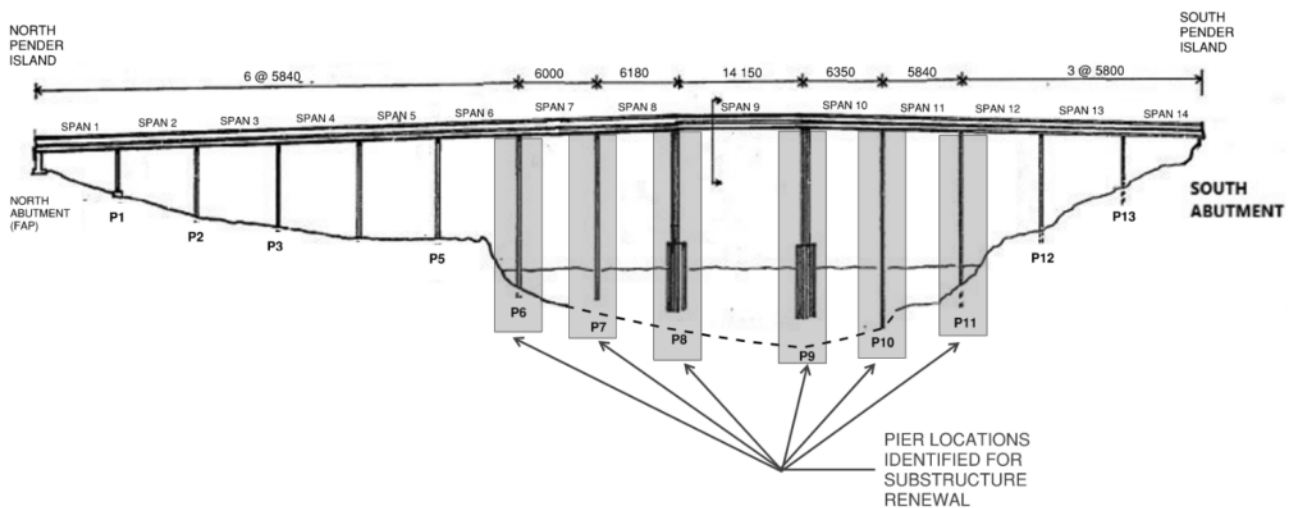


Figure 3 - Substructure Renewal Locations

In McElhanney's 2018 report, nine (9) renewal concepts were identified to address the deteriorated substructure. These are provided below in Table 1, along with the rank based on the evaluation matrix which considered factors including durability, traffic impact, navigation, constructability, initial cost, and life-cycle net present value.



Table 1 - Summary of Previously Identified Substructure Renewal Concepts

Concept	Description	2018 Evaluation Matrix Rank	2020 Detailed Design Phase Comments
1	"Status Quo" – Replace with Timber Piles	7	Not considered, due to current required intervention interval
2	Replace Existing Timber Piles with Wrapped Timber Piles	3	Does not meet intended design life of substructure renewal
3	Replace Existing Piles with New Steel Piles	1	Strongly considered for implementation
4	Advanced Timber Restoration 1 – "Hourglass Patch"	5	Based on recent tender bid results for a similar MOTI bridge project, this concept was not cost competitive compared to a steel pile replacement concept, likely due to the method being considered as a proprietary rehabilitation method using proprietary materials and thus may not be familiar to local Contractors. In addition, for this project much of the pile deterioration is in the fully submerged zone for which close contact access to the deteriorated pile areas will be difficult. The success of this labor-intensive method is also contingent on there being a competent pile core remaining to encapsulate.
5	Advanced Timber Restoration 2 – Section or Whole Posting	6	Same comment as above for Concept 4 except encapsulation of competent core is not applicable.
6	Advanced timber Restoration 3 – Fibre Wrap & Epoxy Injection	4	Same comment as above for Concept 4.
7	Encasing Bottom of Existing Timber Piles with Stainless Steel Reinforced Concrete Pedestals	8	Encasing of timber piles has shown to not provide sufficient design life of repairs due to entrapment of moisture and potentially accelerating timber deterioration.
8	Construction of New Concrete Pedestals & Lengthening Span 9	2	Strongly considered for implementation
RPL	New Bridge on Parallel Roadway Alignment	Not considered	

Concept 8 was the previously recommended renewal concept to carry forward as it would also increase the navigation channel width beneath the bridge. For the purposes of this memo, Concepts 3 and 8 will be further explored.



Concept 3 – Replace Existing Piles with New Steel Piles

This concept involves the installation of new steel piles adjacent to the existing timber elements at Piers 6 to 10. The steel piles would be between 310mm to 610mm outer diameter and have a corrosion allowance considered in the design to account for future section loss due to corrosion. To secure the new steel piles to the superstructure, transverse sub-caps would be located directly below the existing caps, secured by shimming and through-bolted connections. **Figure 4** provides a sketch of the concept.

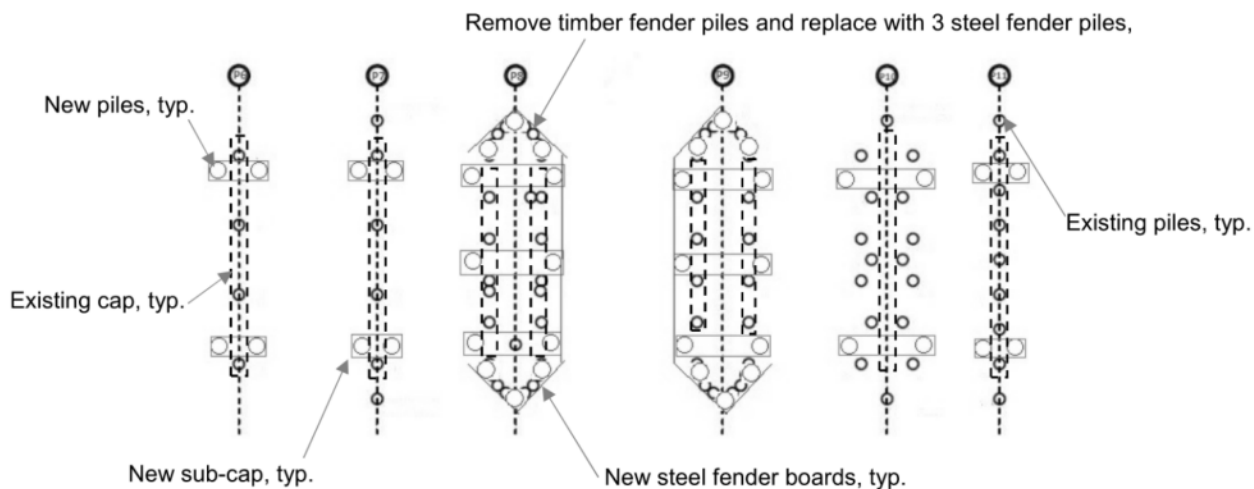


Figure 4 - Concept 3 Sketch

Concept 8 – Construction of New Concrete Pedestals & Lengthening Span

This concept involves the concrete encapsulation of the existing Pier Nos. 6, 7, 10 and 11 and construction of new concrete piers at Pier 8 and Pier 9. Pier 8 and Pier 9 would be replaced by new concrete piers installed outboard of the existing piers and the main span (span 9) would be lengthened. The new concrete piers would support new steel pipe columns and timber caps, and a new or modified existing steel girder superstructure would be placed on the new caps. **Figure 5** provides a sketch of this concept.

One of the biggest challenges with Concept 8 involves the extent of concrete works which would be required in-water. Pier Nos. 6, 7, 10 and 11 would have the existing timber piles encased in concrete from the seabed to the upper intertidal zone. The extent of cast-in place concrete and associated formwork would be significant and likely require extensive environmental permitting and possible habitat compensation requirements by Fisheries & Oceans Canada (DFO).

The existing timber piles and associated cross-bracing would remain unaffected from the concrete pier to the pile caps. The concrete encasement in some historical cases has shown to continue deteriorating the timber pile as water is entrapped between the concrete and timber (differential thermal expansion / structural stiffness) leading to fungal decay in the timber elements.

The 2012 WorleyParsons report identified established erosion / scour of previous concrete encasement repairs, notably at Pier Nos. 5 and 7. Based on our understanding of the current flow in this area during tidal fluctuations, concrete piers may be vulnerable to scour/undermining leading to loss of seabed bearing and increased axial loads on the existing timber piles.

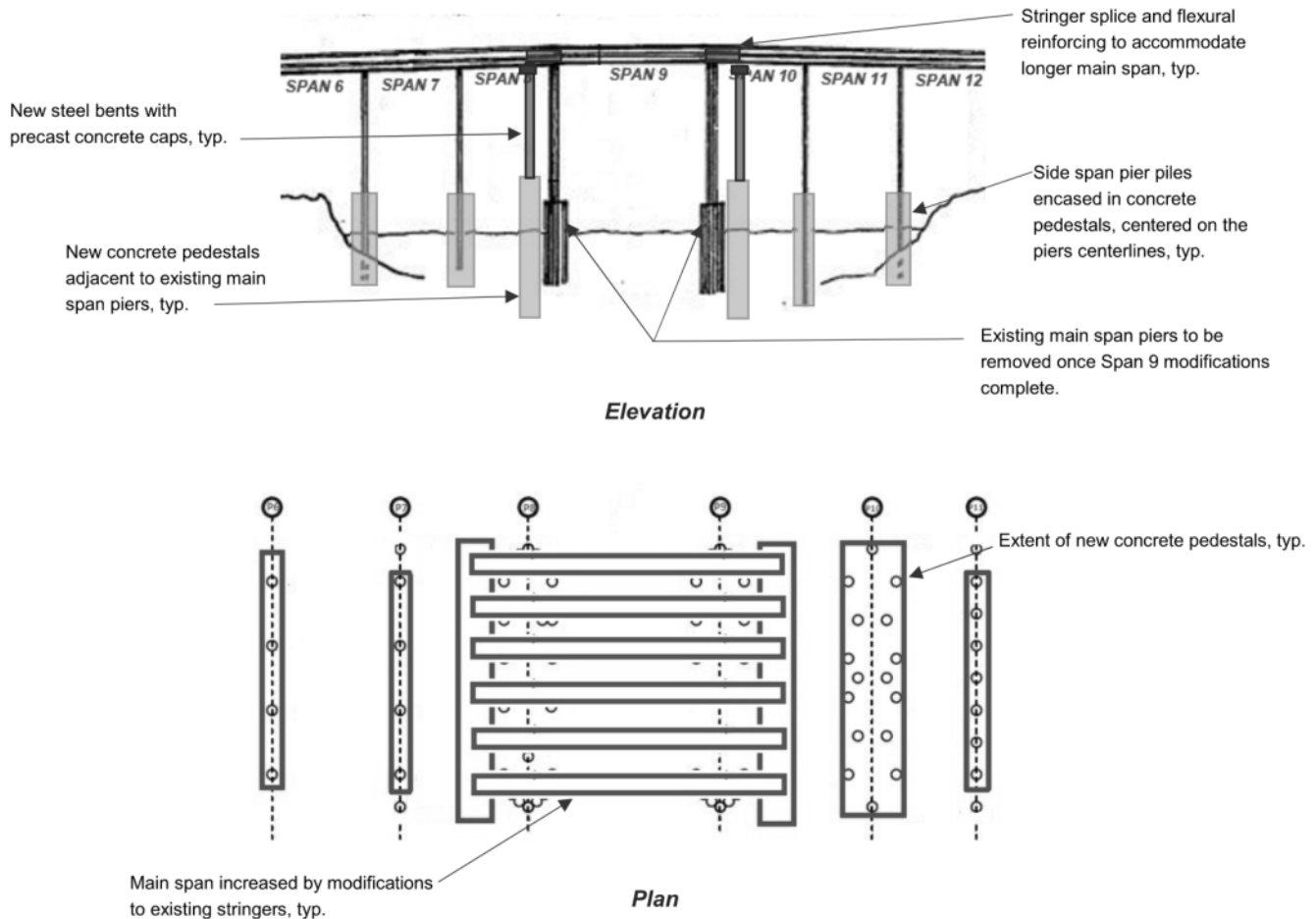


Figure 5 - Concept 8 Sketch

Geotechnical Considerations

Thurber Engineering has been engaged by McElhanney to provide geotechnical input for the substructure renewal, including foundation bearing capacity and pile capacity recommendations. Field investigation work is anticipated in the next 2-3 months to provide input for design and will be completed using a shore-based track drilling rig to advance 2 to 3 boreholes at least 15 m below the bedrock surface. MOTI has indicated that the use of geotechnical resistance factors based on a "low" degree of understanding would be acceptable in order to limit the extent of geotechnical site investigations required and to avoid over-water work. Geotechnical design parameters for structural design of bridge upgrades will be based on the results of the drilling investigation and laboratory testing of bedrock core samples.

Given the lack of soil cover over bedrock within the channel, it is expected that if steel pipe piles are used to replace the foundation elements, the piles would include sockets drilled into the bedrock to provide toe fixity, to help resist seismic uplift forces, and to protect against potential scour.



Environmental Considerations

Based on the footprint of the substructure renewal works, McElhanney will need to submit a Request for Review (RFR) to Fisheries & Oceans Canada (DFO) as there are anticipated in-water works and impacted marine habitat. An RFR is a request to seek advice from DFO regarding the potential for serious harm to fish and harmful alteration, disruption, and destruction of fish habitat (HADD). The RFR will identify the potential risks involved with the conservation and protection of fish and fish habitat present within the project footprint. Due to the proposed use of concrete in the marine environment (Concept 8 only) and the potential for pile driving in the vicinity of Southern Resident Killer Whale critical habitat, McElhanney recommends an RFR so that DFO has the opportunity to outline any project specific mitigation measures and requirements. DFO's response to the RFR may be that they issue a letter of advice with specific mitigation measures and thresholds to follow, or alternatively they deem that an Authorization is required based on the renewal concept and construction methods proposed, and if any aquatic species at risk are found during the habitat assessment. One of the primary measures used to prevent the death of fish and HADD is to plan in-water work around the DFO timing windows. This site is within DFO's Area 18, which has a window of least risk being from July 1-Oct 1, and Dec 1 to Feb 15. Any work outside of these dates will need permission from DFO.

Currently, the anticipated turnaround time for RFR responses is approximately six months. Based on preliminary project team discussions, Concept 3 is anticipated to require significantly less permitting effort than Concept 8.

Archeology Considerations

McElhanney understands that MOTI will undertake all archeological investigations to determine the extent of any desktop studies and impacted locations.



RECOMMENDATIONS & NEXT STEPS

Concepts 3 and 8 have been highlighted from the 2018 McElhanney report as feasible concepts for the substructure renewal. **Table 2** below provides a comparison of the initial capital cost, life cycle cost, and other considerations.

Table 2 - Comparison of Recommended Concepts

Concept	Description	Cost Estimate (see notes below)	Concept Benefits	Concept Risk / Limitations
3	Replace Existing Piles with New Steel Piles	\$950,000	<ul style="list-style-type: none"> Higher contractor availability Faster construction duration. 	<ul style="list-style-type: none"> Pile driving in geotechnically sensitive / low-understanding environment.
8	Construction New Concrete Pedestals & Lengthening Span 9	\$1,800,000	<ul style="list-style-type: none"> Increased vessel navigation channel width. New superstructure at Span 9. 	<ul style="list-style-type: none"> Possibility of seabed erosion of the concrete piers from current flows Encased timber piles may continue to deteriorate based on interaction with concrete. Higher construction cost

**estimate updated from 2018 report to reflect current market conditions and includes capital cost, 15% contingency, 25% engineering & project supervision, and risk. Estimate should be considered Class C, accurate to $\pm 40\%$*

Based on McElhanney's review of the substructure renewal concepts, **Concept 3 is recommended for detailed design.**

CLOSURE

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McElhanney Ltd.

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Reviewed by:

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Senior Bridge Engineer

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Re
06880 Canal Road Bridge:
Substructure Renewal Recommendations

Date
February 16, 2021

BACKGROUND

McElhanney Ltd. (McElhanney) is currently completing detailed design of substructure rehabilitation to the 06880 Canal Road Bridge, located on Pender Island BC. To confirm the scope of rehabilitation renewal work, McElhanney completed a site visit on November 24, 2020 to review the condition of the bridge substructure.

Figure 1 provides the reference identification system currently used by McElhanney.

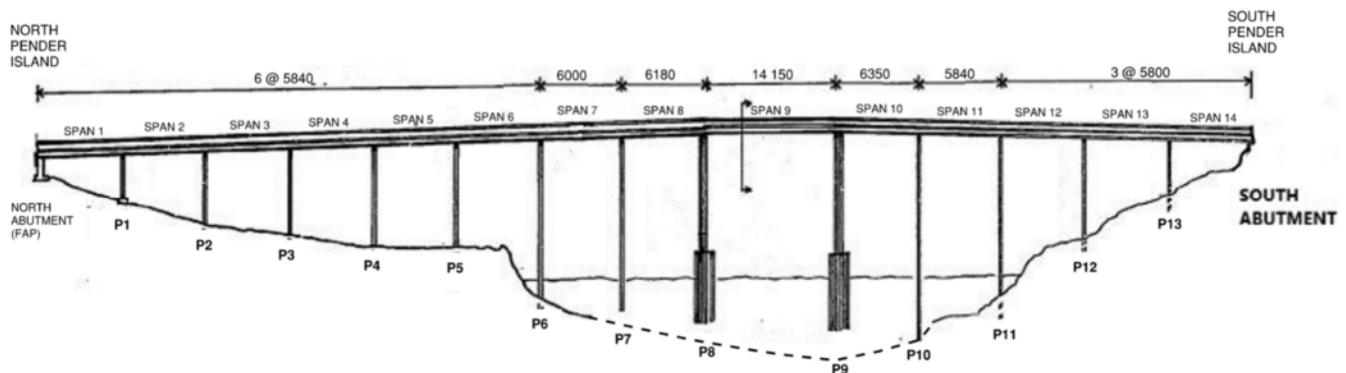


Figure 1 – Structure Elevation

The review consisted of an above water visual inspection of the timber elements including the piles and cross-bracing from the bridge shore area and topsides and was limited to observing locations of obvious damage and/or deterioration based on visual inspection, hammer sounding of the timber elements, and selective timber drilling to identify internal fungal decay. No close-proximity visual inspection or underwater condition assessment was completed for the submerged portion of the piles at Piers 6 to 11.



BRIDGE CONDITION

Table 1 provides a general summary of the condition of each pier bent as observed from the north and south foreshore areas. Inspection Photos are provided in **Appendix A**.

Table 1 - Summary of Previously Identified Substructure Renewal Concepts

Location	General Description of Condition	Recommended Action Items
Bridge Topsides	<ul style="list-style-type: none"> Minor localized erosion/settlement of north and south approaches (<i>Photos 1 and 2</i>). Asphalt wearing surface has widespread cracking and deterioration (<i>Photo 3 and 4</i>). Handrails and curbs have moderate weathering and splitting (<i>Photo 5</i>). 	Monitor
North Abutment	<ul style="list-style-type: none"> Typical water ingress and staining of timber deck and stringers (<i>Photo 6</i>). Minor gaps in timber bulkhead wall. Minor slope failures of adjacent slope area. 	Monitor
Pier 1	<ul style="list-style-type: none"> Typical water ingress and minor surface fungal decay of timber elements (<i>Photo 7</i>). Cross bracing appears well secured to the support posts. Support posts are supported on cast-in-place spread footings. 	Monitor
Pier 2	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of timber elements (<i>Photo 8</i>). Pile B (2nd from east side) has a timber sub-cap block installed. Cross bracing appears well secured to the timber piles. 	Monitor
Pier 3	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of timber elements (<i>Photos 9 and 10</i>). Cross bracing appears well secured to the timber piles. 	Monitor
Pier 4	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of timber elements (<i>Photo 11</i>). Cross bracing appears well secured to the timber piles. The middle east and west piles have evidence of previous clamps installed at the groundline. Clamps appear to have failed (<i>Photos 12 and 13</i>). 	Monitor
Pier 5	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of timber elements (<i>Photo 14</i>). Cross bracing appears well secured to the timber piles. Minor erosion of the ground at the base of the piles due to water current at high tide (<i>Photo 15</i>). Erosion and undermining of the concrete foreshore wall between Piers 5 and 6 (<i>Photo 16</i>). 	Monitor



Location	General Description of Condition	Recommended Action Items
Pier 6	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the exposed timber elements (<i>Photos 17 to 18</i>). Previous WorleyParsons report identified significant deterioration of the timber piles in the submerged zone due to marine borer activity. 	Substructure Renewal
Pier 7	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the exposed timber elements. Previous WorleyParsons report identified significant deterioration of the timber piles in the submerged zone due to marine borer activity (<i>Photo 19</i>). 	Substructure Renewal
Pier 8	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the exposed timber elements. Previous WorleyParsons report identified significant deterioration of the timber piles in the submerged zone due to marine borer activity (<i>Photo 20</i>). 	Substructure Renewal
Pier 9	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the exposed timber elements. Previous WorleyParsons report identified significant deterioration of the timber piles in the submerged zone due to marine borer activity. 	Substructure Renewal
Pier 10	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the exposed timber elements. Previous WorleyParsons report identified significant deterioration of the timber piles in the submerged zone due to marine borer activity (<i>Photo 21</i>). Additional low pile caps and replacement piles have been installed since original construction. 	Substructure Renewal
Pier 11	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the exposed timber elements. Previous WorleyParsons report identified significant deterioration of the timber piles in the submerged zone due to marine borer activity (<i>Photos 22 and 23</i>). 	Substructure Renewal
Pier 12	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the timber elements (<i>Photo 24</i>). Cross bracing appears well secured to the timber piles. 	Monitor
Pier 13	<ul style="list-style-type: none"> Typical water ingress and minor localized surface fungal decay of the timber elements (<i>Photos 25 and 26</i>). Cross bracing appears well secured to the timber piles. 	Monitor



Location	General Description of Condition	Recommended Action Items
South Abutment	<ul style="list-style-type: none"> Minor gaps in timber bulkhead wall with backfill water ingress. Typical water ingress and staining of timber deck and stringers (<i>Photo 27</i>) Minor slope failures of adjacent slope area. Pile cap and corbel block are not adequately secured (<i>Photo 28</i>). 	Install Steel Straps Between Adjacent Pile Cap Sections and Corbel Block.

RECOMMENDATIONS & NEXT STEPS

The site review confirmed that the scope of substructure renewal works should include Piers 6 to 11 as shown in **Figure 2**. While there are several small repairs at the remaining pier and abutment locations, the extent of deterioration at the remaining substructure locations do not necessitate immediate substructure renewal.

McElhanney is currently completing detailed design of substructure renewal at the locations identified in **Figure 2**.

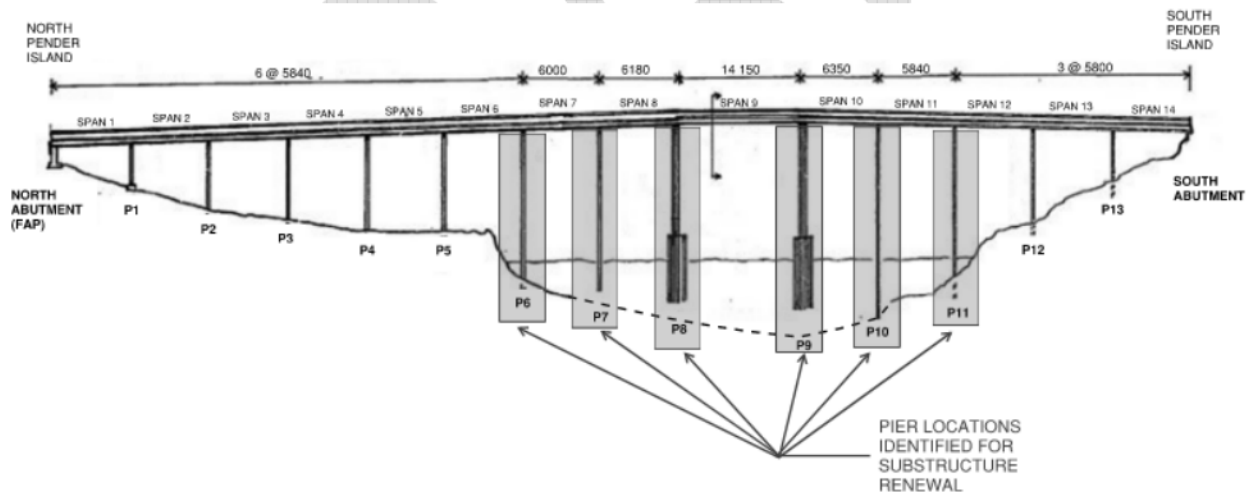


Figure 2 - Substructure Renewal Locations



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McElhanney Ltd.

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Bridge Engineer of Record / Marine Structural Engineer

Reviewed by:

Ernie Wong, P.Eng.
Senior Bridge Engineer



Photo 1 – North Bridge Approach Area



Photo 2 – North Bridge Approach Area



Photo 3 – Typical View of Bridge Topsides



Photo 4 – Deterioration of Asphalt Wearing Surface



Photo 5 – Typical Condition of Timber Curb and Handrail



Photo 6 – North Abutment Typical View



Photo 7 – Pier 1 Typical View



*Photo 8 – Pier 2 Typical View
(sub-cap installed under Pile B, second from east [right] side)*



Photo 9 – Pier 3 Typical View



Photo 10 – Pier 3 Typical View



Photo 11 – Pier 4 Typical View



Photo 12 – Pier 4 Failed Pile Clamp Repair



Photo 13 – Pier 4 Substructure Piles at Groundline

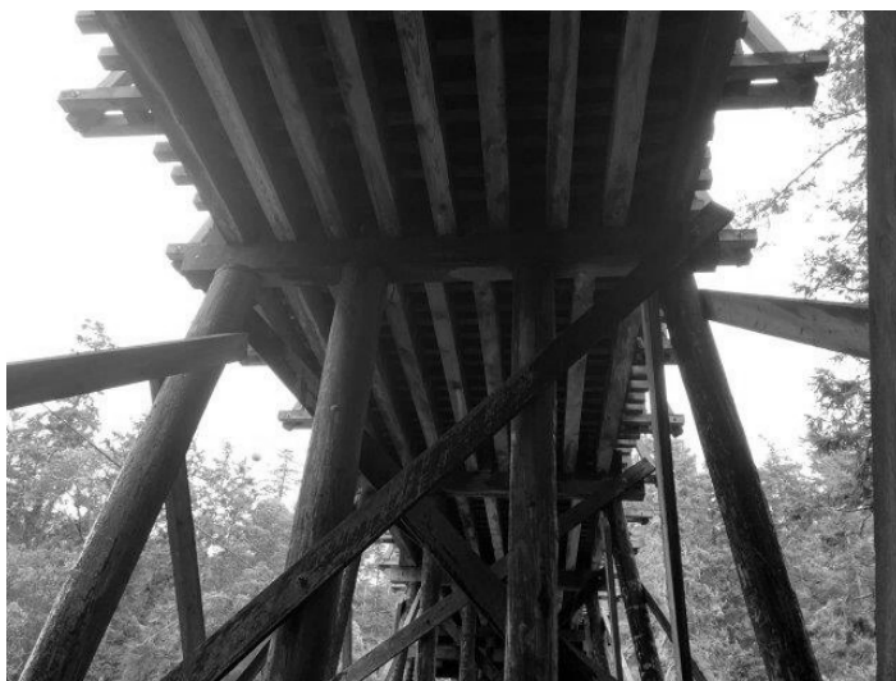


Photo 14 – Pier 5 Typical View



Photo 15 – Pier 5 Erosion at Base of Piles



Photo 16 – Pier 5 to Pier 6



Photo 17 – Pier 6 Typical View at Waterline



Photo 18 – Pier 6 Typical View at Top of Piles



Photo 19 – Piers 7 to 10, North Face, Looking Towards South Abutment



Photo 20 – Piers 8 to 10, North Face, Looking Towards North Abutment



Photo 21 – Pier 10 Typical View, North Face



Photo 22 – Pier 11 Typical View, North Face



Photo 23 – Pier 11 Typical View



Photo 24 – Pier 12 Typical View



Photo 25 – Pier 13 Typical View, Looking Towards South Abutment



Photo 26 – Pier 13 Typical View, Looking North



Photo 27 – South Abutment Typical View



Photo 28 – Pile Cap and Corbel Block Inadequately Secured

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
 - Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

RFI: 01-B-P-00470 - Canal Road - ON

Features Crossed: CANAL / BROWNING HBR

Component Group/Component		E	G	F	P	V	X	N/A
HYDROTECHNICAL :								
1.	Debris Risk			100				N
2.	Channel		100					N
3.	Erosion Protection		100					N
4.	Substructure Scour			100				N
SUBSTRUCTURE :								
5.	Foundation Movement		100					N
6.	Abutments		95	5				N
7.	Wing/Retaining Walls		100					N
8.	Embankment		100					N
9.	Footings/Piling		50	15	10	25		N
11.	Bearings		100					N
12.	Caps			97	3			N
13.	Corbels		90			10		N
14.	Dolphins/Fenders			55		45		N
SUPERSTRUCTURE :								
16.	Stringers		99			1		N
17.	Girders		90	10				N
19.	Bracing/Diaphragms		100					N
28.	Live Load Vibration		100					N
DECK :								
30.	Sub Deck/Cross Ties		95		5			N
31.	Wearing Surface			90		10		N
33.	Curbs/Wheelguards		90	10				N
35.	Railings/Parapets		100					N
APPROACHES :								
39.	Signing/Lighting		100					N
40.	Roadway Approaches		100					N
41.	Roadway Flares		100					N

1st Abutment Position: W

Year Built: 1955 Estimated? ☐

Length (m): 90.900

Note: The first abutment is West which is on the North Pender end. The East abutment is at the widened end of the bridge.

Main Span Length: 15.300

Main Span Type: STRINGER

Spans: 14

Urgency: 3

BCI Rating:

Adjusted BCI Rating:

Inspector/Inspected By: Jeff Ray/TM

On 2022/04/04

Amendment/Partial Inspection?

Urgency Notes:

Urgency Rating Note: Rot in the corbels at water level on pier 10
 Flares not attached to the ends of the bridge
 Underwatering inspection of the piles

Item Notes:

- 1 . Debris Risk

2013: No debris noted at the time of the inspection
 2018: LOD hung up on Bents 9 and 10, MC notified
 2019: LOD removed last summer. No observed concerns

 2022: no observed concerns
- 2 . Channel

2013: Ocean channel between the north and south islands; Skew is straight under the bridge; Banks are solid rock both sides; Bed is solid; Adequacy is good at main span in number 9 where boats pass through
 2016: vessel height clearance under the structure is posted for 9.03m
 2017: horizontal channel clearance needed
 2022: no observed concerns
- 3 . Erosion Protection

2013: Small rock retaining wall on the east side of bent 5 has some erosion under the south end of the wall
 2022: no observed changes

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

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Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- | | |
|--------------------------|--|
| 4 . Substructure Scour | 2002: South Pender bank scouring, not affecting bridge.
2003: Bank scour beside south Pender bank not a problem yet
2004: Bank scour on the south Pender bank has created problems, the first bent is in the intertidal zone and has settled. New piles have been driven at this location to address the problem.
2008: some minor scour under the rock wall on the north pender side
2010: same
2012: photos taken of north side rock wall scour. continue to monitor
2013: erosion under the sound end of the rock retaining wall on the east side of Bent 5; dirt on both banks is being eroded off the base rock
2020: Culvert on south pender needs to be replaced as it is rotten and causing erosion to pile on pier 12
2022: no observed changes |
| 5 . Foundation Movement | 2011: 1st pier in water on south pender side settled in 2004 and new piles had to be driven. stable since then but need to monitor
2012: continue to monitor
2013: no movement noted at the time of the inspection
2022: no observed concerns |
| 6 . Abutments | 2013: West abutment (north Pender side) has concrete footing and 100 by 310 creosoted timber planks in good condition; East abutment has 100 by 400 treated ballast planks in good condition
2014: no observed concerns
2015: south abut ("east" on design cap is sectioned and one section has rot. Cap to be replaced with one single timber
2016: south (east) abutment cap replaced last summer.
2019: East Abut/Pile 5 (from U/S) has developed a 1/8" gap between the pile top and the cap. MC notified and instructed to tie the pile to the cap with vertical fishplate.

2020: tie completed last summer. rot observed in East Abut jump cap
2022: no observed changes |
| 7 . Wing/Retaining Walls | 2013: Short extensions of the abutment ballast planks
2022: no observed concerns |
| 8 . Embankment | 2013; No embankment scour noted at the time of the inspection
2020: Culvert on south pender needs to be replaced as it is rotten and causing erosion to pile on pier 12
2022: no observed changes |

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Item Notes:

9 . Footings/Piling

prior 2002: detailed inspection from 1999 in bridge file

2002: Access

2003: See underwater report - redundancy check shows no immediate concern

2004: several new pilings installed; Pier 8 had underwater repair to non functioning pile that was located on boulder (rock dowells and tremied concrete at the base of the pile); 4 additional piles driven at pier 8; pier 5 had several piles driven to address recent settlement. Details of the 2004 piling repairs are in the bridge files; 2003 underwater inspections marked up to reflect new work

2008: 2 piles on 4th pier from north side sound hollow approx 1.0 m. above ground el.

2010: pier 4 from north pender end has an interior pile that sounds hollow, marked with blue paint

2012: north east footing #1 sounds hollow. marked with red X and photo; Two bents on Pier #2 (from north) are barnacled but well above HWM. Were these salvaged from somewhere? (photos taken); Mid-span piers have a lot of marine growth (photos)

2013: Snooper inspection but unable to tap most piles because of the cross bracing between the bents; tops of piles checked and okay; heavy marine growth on the piles in the water; West abutment concrete footing in good condtion; Bent 1 is Pony bent concrete footing; tapped 2nd vertical at the top and it is loose with one 3-inch nail appears to be all that holds it in place; Bent 2 have barnacles on piles 2A and 2B even though the bent is above high water and a short 300 by 300 creosoted block added on top of pile 2B; Bent 4 has 2 by 4's and strapping added at the bottom of pile 4C appears to be to stop checks from spreading; Bents 2 to 7 have 4 creostoed timber piles in each; Bent 8 (pier 1) has double row of creosoted timber piles & sheathing planks on the east side and fender piles both ends with top rot in the fender piles both ends; Bent 9 (pier 2) has double row of creosoted timber piles with sheathing planks on the west side and fender piles at both ends with top rot in the fender piles; Bent 10 (pier 3) is 3 rows of creosoted timber piles and center row of piles sit on 300 by 300 creosoted timber; Bent 11 is 9 creosoted timber piles & piles 11D, 11F and 11H have timber shims at the top; Bent 12 is 4 creosoted timber piles; Bent 14 is 5 creosoted timber piles; Pile bracing along the piles and crossbracing between the bents

2014: US pile on Bent 11 (photo) needs banding. MC notified

2014js: Inspected by Regional team with extension ladder. Piers 1 to 4 and # 13 were sounded full length and are good condition. First 2.5m on all other land piles were sounded and are good. BAM note from early 2014 inspection as well.

2015: the Worley-Parsons dive survey from 2012 was "rediscovered" this winter and it identified a number of piles for replacement. The piles it identified have now been marked in the field with orange paint. Note that the W-P dive survey used the East (south island) abutment as 1st, so their pier count is backwards. Pier #9 (pier#6 in the W-P report) was rebuilt, at some time prior to 1993, with a pony-pier arrangment consisting of 8 short piles supporting two caps,, which in tuurn support 4 corbels, which in turn support a single cap, which in turn supports 4 trestle-piles. The whole configuration is rotten and needs to be torn out & replaced with full length piles.

2020rbi: Bent1 column A&C showing crushing, column B not supporting any weight (requires shims)

2021: shims installed

2022: no observed changes

11 . Bearings

2013: Full width steel plates welded to the bottoms of the stringers at both ends of span 9

2018: Snooper Inspection, no observed concerns

2022: no access this inspection

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
 - Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

12 . Caps

2002: New caps
 2003 (and 2002): Access
 2011: south pender abut cap starting to sound a bit soft, drill next inspection
 2012: schedule drill for 2013
 2013: most of the caps were accessed by Snooper but not able to tap full length due to the crossbracing between the bents; 300 by 300 creosoted timber caps at both abutments; treated caps on approach spans both ends; creosoted timber caps on piers 1 and 2; Bent 10 double treated caps 300 by 300 on the west side; 3 treated caps 200 by 200 on the east side
 2014: no access from ground
 2014js: Inspected by Regional team with extension ladder. Caps on Piers 1 to 4 and # 13 were sounded and are good. #3 has a full length split along bottom side. #13 has a split 3/4 length in on the east end. East Abut has two caps with corbel midspan. North cap has 450mm of rot in from center over corbel. Monitor
 2015: Pier #9 (pier #6 in the 2012 W-P survey) was rebuilt with a goofy pony-pile at some time prior to 1993. This rebuild consists of 8 short piles supporting two caps, which in turn support 4 corbels, which in turn support a single cap. The whole arrangement is a hot mess of rot and decay and needs to be torn out and the pier rebuilt with full-length piles.
 2020: east abut jump cap has rot developing
 2020rbi: east abut cap has rot in center both pieces
 2022: no observed changes - MC notified to review during re-deck

13 . Corbels

2013: Bent 8 (pier 1) Corbel blocks at top of bent 8 in good condition; Bent 9 corbels on top caps in good condition; Bent 10 corbels at water level have rot starting in the west end
 2015: the corbels in Pier#9 are all rotten
 2022: ground access only. no observed changes

14 . Dolphins/Fenders

2003: See underwater inspection report
 2004: addressed the worst condition fender piles at the north end of Pier 8 by installing 2 new piles
 2012: lots of marine growth
 2013: fender planks generally in good condition but with extensive marine growth on the planks in the water; fender piles on bents 8 and 9 have top rot; extensive marine growth at the bottom of the piles in the wetted area
 2014: no access this inspection
 2015: there are 36 fender piles and 10 of them are rotten and need replacing
 2022: no observed changes

16 . Stringers

prior 2002: First four spans from south abutment have sig. rot at ends of stringers, caps have been cleated to provide more bearing area
 2002: Access. (New stringers)
 2003: all new in last eight years
 2012: no observed concerns
 2013: stringers in good condition; Span 1 is 9 treated timber stringers 400 deep by 150 wide; Span 2 to 8 are 9 treated timber stringers 400 deep by 200 wide; Span 9 is 6 steel stringers with minor corrosion on the top and bottom flanges; Span 10 is 8 treated timber stringers 400 deep by 200 wide; Span 11 & 12 are 9 treated timber stringers 400 deep by 200 wide; Span 13 is 10 treated timber stringers 400 deep by 200 wide; Span 14 is 12 treated timber stringers 400 deep by 200 wide
 2014: THIS COMPONENT NOW ONLY REFERS TO THE WOODEN STRINGERS. THE STEEL GIRDERS WILL BE TRACKED IN LINE 17.
 2022: Stringer 1A is rotten - MC notified to replace

17 . Girders

2014: THIS COMPONENT IS FOR THE STEEL GIRDERS ONLY. WOODEN STRINGERS ARE IN LINE 16. No access this inspection
 2018: Snooper inspection. flake corrosion along all girder flanges. MC to scour and apply corrosion inhibitor by 2023
 2022: Redeck to occur in 2022 - MC requested to apply ship to shore

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Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 19 . Bracing/Diaphragms
 2002: Access. (Some braces starting to rot)
 2003: Some poor sections
 2004: 12 new braces installed this year
 2012: heavy marine growth below HWM and one south brace showing decay. MC notified
 2013: bracing between the bents in good condition; timber diaphragms between the steel stringers with tension rods to hold them tight
 2014: no observed concerns
 2015: pocket rot in east brace, between Piers #3 and #4. bracing below HWM on Piers #7 and #9 are rotten
 2016: marine growth below HWM removed last summer
 2017: marine growth will require another scraping in 2018
 2019: new bracing added and marine growth scraped last month.
 2021: marine growth needs removing
 2022: no observed changes - MC notified to try and scrape if snoopers can reach
- 28 . Live Load Vibration
 2012: significant vibration felt with passenger cars
 2013: long piles with small diameter and only 4 piles on most bents allows movement; pile bracing and bracing between the bents helps but there was still excessive movement under the Snooper loading
 2021: no observed changes
- 30 . Sub Deck/Cross Ties
 2013: Treated crossties in good condition
 2018: crossties set over girder stiffeners were 90-degree notched during installation, resulting in grain shear failure at notches. MC notified to replace these crossties during next deck replacement
 2022: no observed changes - MC notified to replace cracked crossties during re-deck
- 31 . Wearing Surface
 2005: several planks have poor ends due to rot
 2006: same comment as 2005, worst planks have been replaced
 2007: several planks are at end of lifespan one has broken end that will need a repair prior to re-deck this June 2008: chip seal worn off in wheeltracks
 2009: chip seal worn off in wheel tracks
 2010: chip seal was redone this year and is wearing in several areas
 2011: same
 2012: chipwear and rutting evident throughout. south end chip worn away to planks. MC notified (see photos)
 2013: chipseal over untreated deck planks; wear and exposed planks in wheelpaths; cracks in the chip seal; extensive cracking and missing chip seal at the east end
 2014: no change. MC to spray patch and level entire surface this summer
 2014js: Work completed on Oct 22, 2014
 2015: deck planks sounded with no observed concerns. chip surface uneven
 2016: chip gone in numerous spots, chip deformed and pushed in others. MC notified
 2017: no observed changes
 2018: no observed concerns
 2019: minor chip wear. no observed concerns
 2020rbi: exposed deck planks in good condition. Chip failing in spots
 2021: some deck plank replaced - chip continues to fail
 2022: re-deck and chipseal planned for spring 2022
- 33 . Curbs/Wheelguards
 2007: a couple of locations have sig. rot at ends
 2008: approx 50% of wheelguard poor
 2012: curbs all solid with good paint
 2013: painted wheelguards in good condition
 2014: no observed concerns
 2015: all curbs & risers sounded. no observed concerns
 2022: no observed concerns

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Item Notes:

- 35 . Railings/Parapets 2005: wheelguard starting to go soft due to rot in some localized areas, one section on north side that has checks is soft throughout.
 2012: minor warping of some railing caps. MC notified
 2013: numerous top rail boards have warped with small random areas of rot in the top rail board; rails and posts are treated by not painted
 2014: no change. MC notified to replace rotten boards
 2015: rot in two railing caps on west side and 4 railing caps on east side; rot in 1 railing horizontal on west side & 3 railing horizontals on east side
 2016: same. MC to action this summer
 2017: railing components replaced last summer. No observed concerns
 2022: no observed concerns
- 39 . Signing/Lighting 2013: West approach W54's on the ends of the flares and at the ends of the bridge; East approach W54's at the ends of the bridge only
 2022: no observed concerns
- 40 . Roadway Approaches 2013: Approaches level with the ends of the deck; transverse crack in the asphalt at the west approach
 2014: approaches to be spray-patched as part of the deck spray this summer
 2022: no observed concerns
- 41 . Roadway Flares 2013: 7m long flares at all 4 corners; approach speed is 50km; flares are not attached to the ends of the bridge; the flares at the west end of the bridge do not protect the end of the railings
 2022: no observed concerns

Inspection Notes:**General Inspection Notes**

2006: This bridge requires underwater inspection every 5 years and has a history of requiring replacement piles to be driven. considerable repairs were conducted in the early nineties. superstructure should be good till mid 2010 decade but pilings will need close inspection and regular replacements due to marine borers.

2018: snooper inspection

2019: BMIS glitchy and not allowing new inspection photos to be uploaded

2020rbi: Inspected by RBI's

Posted Weight Restriction

Bridge load limit 23,000 kg Tridem axle.

Drainage Area Description

2004 SCOUR OF SOUTH BANK HAS CAUSED PROBLEMS AT

BRIDGE, PIER 5 HAS SETTLED AND NEEDED NEW PILES

2003: Tidal channel, scour at south Pender bank, south side, gradual. AND JACKING UP .

2002: Tidal, scour at south side, not a problem yet.

prior 2002: Tidal canal - navigation channel high usage. ocean channel between pender island.

Rehab Work Notes

2013: secure the flares to the ends of the bridge

PLACE ON REHAB. PROGRAM, REPLACE PRIOR TO NEED FOR NEXT MAJOR MAINTENANCE PROJECT.

2016: SCR Jellema has begun redesign work to replace the wetted Bents with poured concrete piers to above the HWM. From there, the bents will be retrofitted as trestles

2017: McElhanney WONG completed initial site visit May 2017 as part of the rehab project

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Inspection Notes:**Maintenance Work Notes**

prior 2002: Monitor closely, schedule south span stringer replacement, determine repairs to underwater pilings
 2002: Bridge repairs, decide whether to repair or remove old Pier 8 frame
 2003: Schedule pile and bracing repairs, divers shimmed pile at pier 6 on bedrock with woodpin shims I provided. Needs a more permanent repair
 2004: Extensive repairs this year, need to continue monitoring and maintenance as required
 2005: need to redeck in 2006 and replace a few planks to maintain for the winter 05,06 season
 2007: redeck this year, June
 2008: replace poor wheelguard, conduct detailed inspection and clean marine growth off of substructure. repair chip seal
 2009: do detailed inspection re-chipseal
 2010: patch chip seal
 2011: clean up chips from deck, conduct boat and man basket inspection next year
 2012: MC to rechip the deck, clean marine growth and replace the rotted brace. Snooper scheduled for 2013
 2013: chipseal the deck; secure the vertical post in Bent 1; clean the marine growth off the piles; replace the corbels at the bottom of Bent 10
 2014: replace rotten railing plies; band US pile on Bent 11; replace corbels & sheathing on Bent 10; spray patch and level deck
 2015: major pile/brace replacement project planned for January 2016
 2016: pile & brace replacement superceded by SCR rehab plan. Replace rotten railing components, recify deck condition

 2018: remove LOD from Bents 9 and 10; scour and apply corrosion inhibitor to girder flanges; replace broken crossties next redeck
 2021: South abut - install steel straps between adjacent pile caps and corbel blocks - possible rechip in 2022. Discuss with SCR Ho regarding their plan and response to 2021Feb McElhanney report
 2022: same as 2021 - redeck and rechip in 2022, replace cracked cross ties, remove marine growth, scour and corrosion protection on girders, replace stringer 1A

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RFI: 01-B-P-00470 - Canal Road - ON

Features Crossed: CANAL / BROWNING HBR

Component Group/Component		E	G	F	P	V	X	N/A
HYDROTECHNICAL :								
1.	Debris Risk			100				N
2.	Channel		100					N
3.	Erosion Protection		100					N
4.	Substructure Scour			100				N
SUBSTRUCTURE :								
5.	Foundation Movement		100					N
6.	Abutments		95	5				N
7.	Wing/Retaining Walls		100					N
8.	Embankment		100					N
9.	Footings/Piling		50	15	10	25		N
11.	Bearings		100					N
12.	Caps			97	3			N
13.	Corbels		90			10		N
14.	Dolphins/Fenders			55		45		N
SUPERSTRUCTURE :								
16.	Stringers		100					N
17.	Girders		90	10				N
19.	Bracing/Diaphragms		100					N
28.	Live Load Vibration		100					N
DECK :								
30.	Sub Deck/Cross Ties		95		5			N
31.	Wearing Surface			90		10		N
33.	Curbs/Wheelguards		90	10				N
35.	Railings/Parapets		100					N
APPROACHES :								
39.	Signing/Lighting		100					N
40.	Roadway Approaches		100					N
41.	Roadway Flares		100					N

1st Abutment Position: W

Year Built: 1955 Estimated? ☐

Length (m): 90.900

Note: The first abutment is West which is on the North Pender end. The East abutment is at the widened end of the bridge.

Main Span Length: 15.300

Main Span Type: STRINGER

Spans: 14

Urgency: 3

BCI Rating: 2.28

Adjusted BCI Rating: 2.39

Inspector/Inspected By: Jordie Sorensen

On 2020/11/13

Amendment/Partial Inspection?

Urgency Notes:

Urgency Rating Note: Rot in the corbels at water level on pier 10
 Flares not attached to the ends of the bridge
 Underwatering inspection of the piles

Item Notes:

1 . Debris Risk

2013: No debris noted at the time of the inspection

2014: no observed concerns

2015: no observed concerns

2016: no observed concerns

2017: same

2018: LOD hung up on Bents 9 and 10, MC notified

2019: LOD removed last summer. No observed concerns

2020: no observed concerns

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Item Notes:

- 2 . Channel
- 2013: Ocean channel between the north and south islands; Skew is straight under the bridge; Banks are solid rock both sides; Bed is solid; Adequacy is good at main span in number 9 where boats pass through
 2014: no observed concerns
 2015: no observed concerns
 2016: vessel height clearance under the structure is posted for 9.03m
 2017: horizontal channel clearance needed
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 3 . Erosion Protection
- 2013: Small rock retaining wall on the east side of bent 5 has some erosion under the south end of the wall
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 4 . Substructure Scour
- 2002: South Pender bank scouring, not affecting bridge.
 2003: Bank scour beside south Pender bank not a problem yet
 2004: Bank scour on the south Pender bank has created problems, the first bent is in the intertidal zone and has settled. New piles have been driven at this location to address the problem.
 2008: some minor scour under the rock wall on the north pender side
 2010: same
 2012: photos taken of north side rock wall scour. continue to monitor
 2013: erosion under the sound end of the rock retaining wall on the east side of Bent 5; dirt on both banks is being eroded off the base rock
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 5 . Foundation Movement
- 2011: 1st pier in water on south pender side settled in 2004 and new piles had to be driven. stable since then but need to monitor
 2012: continue to monitor
 2013: no movement noted at the time of the inspection
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 6 . Abutments
- 2013: West abutment (north Pender side) has concrete footing and 100 by 310 creosoted timber planks in good condition; East abutment has 100 by 400 treated ballast planks in good condition
 2014: no observed concerns
 2015: south abut ("east" on design cap is sectioned and one section has rot. Cap to be replaced with one single timber
 2016: south (east) abutment cap replaced last summer. no observed concerns
 2017: no observed concerns
 2018: no observed concerns
 2019: East Abut/Pile 5 (from U/S) has developed a 1/8" gap between the pile top and the cap. MC notified and instructed to tie the pile to the cap with vertical fishplate.

 2020: tie completed last summer. rot observed in East Abut jump cap

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Item Notes:

- 7 . Wing/Retaining Walls 2013: Short extensions of the abutment ballast planks
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 8 . Embankment 2013: No embankment scour noted at the time of the inspection
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 9 . Footings/Piling prior 2002: detailed inspection from 1999 in bridge file
 2002: Access
 2003: See underwater report - redundancy check shows no immediate concern
 2004: several new pilings installed; Pier 8 had underwater repair to non functioning pile that was located on boulder (rock dowells and tremied concrete at the base of the pile); 4 additional piles driven at pier 8; pier 5 had several piles driven to address recent settlement. Details of the 2004 piling repairs are in the bridge files; 2003 underwater inspections marked up to reflect new work
 2008: 2 piles on 4th pier from north side sound hollow approx 1.0 m. above ground el.
 2010: pier 4 from north pender end has an interior pile that sounds hollow, marked with blue paint
 2012: north east footing #1 sounds hollow. marked with red X and photo; Two bents on Pier #2 (from north) are barnacled but well above HWM. Were these salvaged from somewhere? (photos taken); Mid-span piers have a lot of marine growth (photos)
 2013: Snooper inspection but unable to tap most piles because of the cross bracing between the bents; tops of piles checked and okay; heavy marine growth on the piles in the water; West abutment concrete footing in good condition; Bent 1 is Pony bent concrete footing; tapped 2nd vertical at the top and it is loose with one 3-inch nail appears to be all that holds it in place; Bent 2 have barnacles on piles 2A and 2B even though the bent is above high water and a short 300 by 300 creosoted block added on top of pile 2B; Bent 4 has 2 by 4's and strapping added at the bottom of pile 4C appears to be to stop checks from spreading; Bents 2 to 7 have 4 creosoted timber piles in each; Bent 8 (pier 1) has double row of creosoted timber piles & sheathing planks on the east side and fender piles both ends with top rot in the fender piles both ends; Bent 9 (pier 2) has double row of creosoted timber piles with sheathing planks on the west side and fender piles at both ends with top rot in the fender piles; Bent 10 (pier 3) is 3 rows of creosoted timber piles and center row of piles sit on 300 by 300 creosoted timber; Bent 11 is 9 creosoted timber piles & piles 11D, 11F and 11H have timber shims at the top; Bent 12 is 4 creosoted timber piles; Bent 14 is 5 creosoted timber piles; Pile bracing along the piles and crossbracing between the bents
 2014: US pile on Bent 11 (photo) needs banding. MC notified
 2014js: Inspected by Regional team with extension ladder. Piers 1 to 4 and # 13 were sounded full length and are good condition. First 2.5m on all other land piles were sounded and are good. BAM note from early 2014 inspection as well.
 2015: the Worley-Parsons dive survey from 2012 was "rediscovered" this winter and it identified a number of piles for replacement. The piles it identified have now been marked in the field with orange paint. Note that the W-P dive survey used the East (south island) abutment as 1st, so their pier count is backwards. Pier #9 (pier#6 in the W-P report) was rebuilt, at some time prior to 1993, with a pony-pier arrangement consisting of 8 short piles supporting two caps,, which in turn support 4 corbels, which in turn support a single cap, which in turn supports 4 trestle-piles. The whole configuration is rotten and needs to be torn out & replaced with full length piles.
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: no observed changes

 2020: no observed changes
 2020rbi: Bent1 column A&C showing crushing, column B not supporting any weight (requires shims)

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Item Notes:

11 . Bearings

2013: Full width steel plates welded to the bottoms of the stringers at both ends of span 9
 2014: no access from ground
 2015: no access this inspection
 2016: no access this inspection
 2017: no access this inspection
 2018: Snooper Inspection, no observed concerns
 2019: no access this inspection

 2020: no access this inspection

12 . Caps

2002: New caps
 2003 (and 2002): Access
 2011: south pender abut cap starting to sound a bit soft, drill next inspection
 2012: schedule drill for 2013
 2013: most of the caps were accessed by Snooper but not able to tap full length due to the crossbracing between the bents; 300 by 300 creosoted timber caps at both abutments; treated caps on approach spans both ends; creosoted timber caps on piers 1 and 2; Bent 10 double treated caps 300 by 300 on the west side; 3 treated caps 200 by 200 on the east side
 2014: no access from ground
 2014js: Inspected by Regional team with extension ladder. Caps on Piers 1 to 4 and # 13 were sounded and are good. #3 has a full length split along bottom side. #13 has a split 3/4 length in on the east end. East Abut has two caps with corbel midspan. North cap has 450mm of rot in from center over corbel. Monitor
 2015: Pier #9 (pier #6 in the 2012 W-P survey) was rebuilt with a goofy pony-pile at some time prior to 1993. This rebuild consists of 8 short piles supporting two caps, which in turn support 4 corbels, which in turn support a single cap. The whole arrangement is a hot mess of rot and decay and needs to be torn out and the pier rebuilt with full-length piles.
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: no observed changes

 2020: east abut jump cap has rot developing
 2020rbi: east abut cap has rot in center both pieces

13 . Corbels

2013: Bent 8 (pier 1) Corbel blocks at top of bent 8 in good condition; Bent 9 corbels on top caps in good condition; Bent 10 corbels at water level have rot starting in the west end
 2014: no observed changes
 2015: the corbels in Pier#9 are all rotten
 2016: ground access only. no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: same

 2020: ground access only. no observed changes

14 . Dolphins/Fenders

2003: See underwater inspection report
 2004: addressed the worst condition fender piles at the north end of Pier 8 by installing 2 new piles
 2012: lots of marine growth
 2013: fender planks generally in good condition but with extensive marine growth on the planks in the water; fender piles on bents 8 and 9 have top rot; extensive marine growth at the bottom of the piles in the wetted area
 2014: no access this inspection
 2015: there are 36 fender piles and 10 of them are rotten and need replacing
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: same

 2020: no observed changes

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Item Notes:

16 . Stringers

prior 2002: First four spans from south abutment have sig. rot at ends of stringers, caps have been cleated to provide more bearing area
 2002: Access. (New stringers)
 2003: all new in last eight years
 2012: no observed concerns
 2013: stringers in good condition; Span 1 is 9 treated timber stringers 400 deep by 150 wide; Span 2 to 8 are 9 treated timber stringers 400 deep by 200 wide; Span 9 is 6 steel stringers with minor corrosion on the top and bottom flanges; Span 10 is 8 treated timber stringers 400 deep by 200 wide; Span 11 & 12 are 9 treated timber stringers 400 deep by 200 wide; Span 13 is 10 treated timber stringers 400 deep by 200 wide; Span 14 is 12 treated timber stringers 400 deep by 200 wide
 2014: THIS COMPONENT NOW ONLY REFERS TO THE WOODEN STRINGERS. THE STEEL GIRDERS WILL BE TRACKED IN LINE 17. No observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns

17 . Girders

2014: THIS COMPONENT IS FOR THE STEEL GIRDERS ONLY. WOODEN STRINGERS ARE IN LINE 16. No access this inspection
 2015: no access this inspection
 2016: no access this inspection
 2017: no access this inspection
 2018: Snooper inspection. flake corrosion along all girder flanges. MC to scour and apply corrosion inhibitor by 2023
 2019: no access this inspection

 2020: no access this inspection

19 . Bracing/Diaphragms

2002: Access. (Some braces starting to rot)
 2003: Some poor sections
 2004: 12 new braces installed this year
 2012: heavy marine growth below HWM and one south brace showing decay. MC notified
 2013: bracing between the bents in good condition; timber diaphragms between the steel stringers with tension rods to hold them tight
 2014: no observed concerns
 2015: pocket rot in east brace, between Piers #3 and #4. bracing below HWM on Piers #7 and #9 are rotten
 2016: marine growth below HWM removed last summer
 2017: marine growth will require another scraping in 2018
 2018: no observed changes
 2019: new bracing added and marine growth scraped last month. no observed concerns

 2020: marine growth needs removing

28 . Live Load Vibration

2012: significant vibration felt with passenger cars
 2013: long piles with small diameter and only 4 piles on most bents allows movement; pile bracing and bracing between the bents helps but there was still excessive movement under the Snooper loading
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed changes
 2019: no observed changes

 2020: no observed changes

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
 - Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 30 . Sub Deck/Cross Ties
 2013: Treated crossties in good condition
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: crossties set over girder stiffeners were 90-degree notched during installation, resulting in grain shear failure at notches. MC notified to replace these crossties during next deck replacement
 2019: no observed changes

 2020: no observed changes
- 31 . Wearing Surface
 2005: several planks have poor ends due to rot
 2006: same comment as 2005, worst planks have been replaced
 2007: several planks are at end of lifespan one has broken end that will need a repair prior to redeck this June 2008: chip seal worn off in wheeltracks
 2009: chip seal worn off in wheel tracks
 2010: chip seal was redone this year and is wearing in several areas
 2011: same
 2012: chipwear and rutting evident throughout. south end chip worn away to planks. MC notified (see photos)
 2013: chipseal over untreated deck planks; wear and exposed planks in wheelpaths; cracks in the chip seal; extensive cracking and missing chip seal at the east end
 2014: no change. MC to spray patch and level entire surface this summer
 2014js: Work completed on Oct 22, 2014
 2015: deck planks sounded with no observed concerns. chip surface uneven
 2016: chip gone in numerous spots, chip deformed and pushed in others. MC notified
 2017: no observed changes
 2018: no observed concerns
 2019: minor chip wear. no observed concerns

 2020: no observed concerns
 2020rbi: exposed deck planks in good condition. Chip failing in spots
- 33 . Curbs/Wheelguards
 2007: a couple of locations have sig. rot at ends
 2008: approx 50% of wheelguard poor
 2012: curbs all solid with good paint
 2013: painted wheelguards in good condition
 2014: no observed concerns
 2015: all curbs & risers sounded. no observed concerns
 2016: no observed concerns
 2017: no observed concerns
 2018: no observed concerns
 2019: same

 2020: no observed concerns
- 35 . Railings/Parapets
 2005: wheelguard starting to go soft due to rot in some localized areas, one section on north side that has checks is soft throughout.
 2012: minor warping of some railing caps. MC notified
 2013: numerous top rail boards have warped with small random areas of rot in the top rail board; rails and posts are treated by not painted
 2014: no change. MC notified to replace rotten boards
 2015: rot in two railing caps on west side and 4 railing caps on east side; rot in 1 railing horizontal on west side & 3 railing horizontals on east side
 2016: same. MC to action this summer
 2017: railing components replaced last summer. No observed concerns
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns

BRIDGE MANAGEMENT INFORMATION SYSTEM

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Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 39 . **Signing/Lighting** 2013: West approach W54's on the ends of the flares and at the ends of the bridge; East approach W54's at the ends of the bridge only
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 40 . **Roadway Approaches** 2013: Approaches level with the ends of the deck; transverse crack in the asphalt at the west approach
 2014: approaches to be spray-patched as part of the deck spray this summer
 2015: no observed concerns
 2016: no observed concerns
 2017: no observed concerns
 2018: no observed concerns
 2019: same

 2020: no observed concerns
- 41 . **Roadway Flares** 2013: 7m long flares at all 4 corners; approach speed is 50km; flares are not attached to the ends of the bridge; the flares at the west end of the bridge do not protect the end of the railings
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns

Inspection Notes:**General Inspection Notes**

2006: This bridge requires underwater inspection every 5 years and has a history of requiring replacement piles to be driven. considerable repairs were conducted in the early nineties. superstructure should be good till mid 2010 decade but pilings will need close inspection and regular replacements due to marine borers.

2018: snoop inspection

2019: BMIS glitchy and not allowing new inspection photos to be uploaded

2020rbi: Inspected by RBI's

Posted Weight Restriction

Bridge load limit 23,000 kg Tridem axle.

Drainage Area Description

2004 SCOUR OF SOUTH BANK HAS CAUSED PROBLEMS AT BRIDGE, PIER 5 HAS SETTLED AND NEEDED NEW PILES

2003: Tidal channel, scour at south Pender bank, south side, gradual. AND JACKING UP .

2002: Tidal, scour at south side, not a problem yet.

prior 2002: Tidal canal - navigation channel high usage. ocean channel between pender island.

Rehab Work Notes

2013: secure the flares to the ends of the bridge
 PLACE ON REHAB. PROGRAM, REPLACE PRIOR TO NEED FOR NEXT MAJOR MAINTENANCE PROJECT.

2016: SCR JEllema has begun redesign work to replace the wetted Bents with poured concrete piers to above the HWM. From there, the bents will be retrofitted as trestles

2017: McElhanney WONG completed initial site visit May 2017 as part of the rehab project

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Region: 1 - South Coast Region

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Inspection Notes:**Maintenance Work Notes**

prior 2002: Monitor closely, schedule south span stringer replacement, determine repairs to underwater pilings

2002: Bridge repairs, decide whether to repair or remove old Pier 8 frame

2003: Schedule pile and bracing repairs, divers shimmed pile at pier 6 on bedrock with woodpin shims I provided. Needs a more permanent repair

2004: Extensive repairs this year, need to continue monitoring and maintenance as required

2005: need to redeck in 2006 and replace a few planks to maintain for the winter 05,06 season

2007: redeck this year, June

2008: replace poor wheelguard, conduct detailed inspection and clean marine growth off of substructure. repair chip seal

2009: do detailed inspection re-chipseal

2010: patch chip seal

2011: clean up chips from deck, conduct boat and man basket inspection next year

2012: MC to rechip the deck, clean marine growth and replace the rotted brace. Snooper scheduled for 2013

2013: chipseal the deck; secure the vertical post in Bent 1; clean the marine growth off the piles; replace the corbels at the bottom of Bent 10

2014: replace rotten railing plies; band US pile on Bent 11; replace corbels & sheathing on Bent 10; spray patch and level deck

2015: major pile/brace replacement project planned for January 2016

2016: pile & brace replacement superceded by SCR rehab plan. Replace rotten railing components, recify deck condition

2018: remove LOD from Bents 9 and 10; scour and apply corrosion inhibitor to girder flanges; replace broken crossties next redeck

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District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

RFI: 01-B-P-00470 - Canal Road - ON

Features Crossed: CANAL / BROWNING HBR

Component Group/Component		E	G	F	P	V	X	N/A
HYDROTECHNICAL :								
1.	Debris Risk			100				N
2.	Channel		100					N
3.	Erosion Protection		100					N
4.	Substructure Scour			100				N
SUBSTRUCTURE :								
5.	Foundation Movement		100					N
6.	Abutments		95	5				N
7.	Wing/Retaining Walls		100					N
8.	Embankment		100					N
9.	Footings/Piling		50	15	10	25		N
11.	Bearings		100					N
12.	Caps		100					N
13.	Corbels		90			10		N
14.	Dolphins/Fenders			55		45		N
SUPERSTRUCTURE :								
16.	Stringers		100					N
17.	Girders		90	10				N
19.	Bracing/Diaphragms		100					N
28.	Live Load Vibration		100					N
DECK :								
30.	Sub Deck/Cross Ties		95		5			N
31.	Wearing Surface			100				N
33.	Curbs/Wheelguards		100					N
35.	Railings/Parapets		100					N
APPROACHES :								
39.	Signing/Lighting		100					N
40.	Roadway Approaches		100					N
41.	Roadway Flares		100					N

1st Abutment Position: W

Year Built: 1955 Estimated? ☐

Length (m): 90.900

Note: The first abutment is West which is on the North Pender end. The East abutment is at the widened end of the bridge.

Main Span Length: 15.300

Main Span Type: STRINGER

Spans: 14

Urgency: 3

BCI Rating: 2.22

Adjusted BCI Rating: 2.35

Inspector/Inspected By: CHRISTOPHER GORD

On 2019/06/18

Amendment/Partial Inspection?

Urgency Notes:

Urgency Rating Note: Rot in the corbels at water level on pier 10
 Flares not attached to the ends of the bridge
 Underwatering inspection of the piles

Item Notes:

1 . Debris Risk

2013: No debris noted at the time of the inspection

2014: no observed concerns

2015: no observed concerns

2016: no observed concerns

2017: same

2018: LOD hung up on Bents 9 and 10, MC notified

2019: LOD removed last summer. No observed concerns

BRIDGE MANAGEMENT INFORMATION SYSTEM

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 2 . Channel
- 2013: Ocean channel between the north and south islands; Skew is straight under the bridge; Banks are solid rock both sides; Bed is solid; Adequacy is good at main span in number 9 where boats pass through
 2014: no observed concerns
 2015: no observed concerns
 2016: vessel height clearance under the structure is posted for 9.03m
 2017: horizontal channal clearance needed
 2018: no observed concerns

 2019: no observed concerns
- 3 . Erosion Protection
- 2013: Small rock retaining wall on the east side of bent 5 has some erosion under the south end of the wall
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed concerns

 2019: no observed concerns
- 4 . Substructure Scour
- 2002: South Pender bank scouring, not affecting bridge.
 2003: Bank scour beside south Pender bank not a problem yet
 2004: Bank scour on the south Pender bank has created problems, the first bent is in the intertidal zone and has settled. New piles have been driven at this location to address the problem.
 2008: some minor scour under the rock wall on the north pender side
 2010: same
 2012: photos taken of north side rock wall scour. continue to monitor
 2013: erosion under the sound end of the rock retaining wall on the east side of Bent 5; dirt on both banks is being eroded off the base rock
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed concerns

 2019: no observed concerns
- 5 . Foundation Movement
- 2011: 1st pier in water on south pender side settled in 2004 and new piles had to be driven. stable since then but need to monitor
 2012: continue to monitor
 2013: no movement noted at the time of the inspection
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns

 2019: no observed concerns
- 6 . Abutments
- 2013: West abutment (north Pender side) has concrete footing and 100 by 310 creosoted timber planks in good condition; East abutment has 100 by 400 treated ballast planks in good condition
 2014: no observed concerns
 2015: south abut ("east" on design cap is sectioned and one section has rot. Cap to be replaced with one single timber
 2016: south (east) abutment cap replaced last summer. no observed concerns
 2017: no observed concerns
 2018: no observed concerns

 2019: East Abut/Pile 5 (from U/S) has developed a 1/8" gap between the pile top and the cap. MC notified and instructed to tie the pile to the cap with vertical fishplate.

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Item Notes:

- 7 . Wing/Retaining Walls 2013: Short extensions of the abutment ballast planks
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns

 2019: no observed concerns
- 8 . Embankment 2013: No embankment scour noted at the time of the inspection
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns

 2019: no observed concerns
- 9 . Footings/Piling prior 2002: detailed inspection from 1999 in bridge file
 2002: Access
 2003: See underwater report - redundancy check shows no immediate concern
 2004: several new pilings installed; Pier 8 had underwater repair to non functioning pile that was located on boulder (rock dowells and tremied concrete at the base of the pile); 4 additional piles driven at pier 8; pier 5 had several piles driven to address recent settlement. Details of the 2004 piling repairs are in the bridge files; 2003 underwater inspections marked up to reflect new work
 2008: 2 piles on 4th pier from north side sound hollow approx 1.0 m. above ground el.
 2010: pier 4 from north pender end has an interior pile that sounds hollow, marked with blue paint
 2012: north east footing #1 sounds hollow. marked with red X and photo; Two bents on Pier #2 (from north) are barnacled but well above HWM. Were these salvaged from somewhere? (photos taken); Mid-span piers have a lot of marine growth (photos)
 2013: Snooper inspection but unable to tap most piles because of the cross bracing between the bents; tops of piles checked and okay; heavy marine growth on the piles in the water; West abutment concrete footing in good condition; Bent 1 is Pony bent concrete footing; tapped 2nd vertical at the top and it is loose with one 3-inch nail appears to be all that holds it in place; Bent 2 have barnacles on piles 2A and 2B even though the bent is above high water and a short 300 by 300 creosoted block added on top of pile 2B; Bent 4 has 2 by 4's and strapping added at the bottom of pile 4C appears to be to stop checks from spreading; Bents 2 to 7 have 4 creosoted timber piles in each; Bent 8 (pier 1) has double row of creosoted timber piles & sheathing planks on the east side and fender piles both ends with top rot in the fender piles both ends; Bent 9 (pier 2) has double row of creosoted timber piles with sheathing planks on the west side and fender piles at both ends with top rot in the fender piles; Bent 10 (pier 3) is 3 rows of creosoted timber piles and center row of piles sit on 300 by 300 creosoted timber; Bent 11 is 9 creosoted timber piles & piles 11D, 11F and 11H have timber shims at the top; Bent 12 is 4 creosoted timber piles; Bent 14 is 5 creosoted timber piles; Pile bracing along the piles and crossbracing between the bents
 2014: US pile on Bent 11 (photo) needs banding. MC notified
 2014js: Inspected by Regional team with extension ladder. Piers 1 to 4 and # 13 were sounded full length and are good condition. First 2.5m on all other land piles were sounded and are good. BAM note from early 2014 inspection as well.
 2015: the Worley-Parsons dive survey from 2012 was "rediscovered" this winter and it identified a number of piles for replacement. The piles it identified have now been marked in the field with orange paint. Note that the W-P dive survey used the East (south island) abutment as 1st, so their pier count is backwards. Pier #9 (pier#6 in the W-P report) was rebuilt, at some time prior to 1993, with a pony-pier arrangement consisting of 8 short piles supporting two caps,, which in turn support 4 corbels, which in turn support a single cap, which in turn supports 4 trestle-piles. The whole configuration is rotten and needs to be torn out & replaced with full length piles.
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes

 2019: no observed changes

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Contract Area: 1 - South Island CA

Item Notes:

11 . Bearings

2013: Full width steel plates welded to the bottoms of the stringers at both ends of span 9
 2014: no access from ground
 2015: no access this inspection
 2016: no access this inspection
 2017: no access this inspection
 2018: Snooper Inspection, no observed concerns

 2019: no access this inspection

12 . Caps

2002: New caps
 2003 (and 2002): Access
 2011: south pender abut cap starting to sound a bit soft, drill next inspection
 2012: schedule drill for 2013
 2013: most of the caps were accessed by Snooper but not able to tap full length due to the crossbracing between the bents; 300 by 300 creosoted timber caps at both abutments; treated caps on approach spans both ends; creosoted timber caps on piers 1 and 2; Bent 10 double treated caps 300 by 300 on the west side; 3 treated caps 200 by 200 on the east side
 2014: no access from ground
 2014js: Inspected by Regional team with extension ladder. Caps on Piers 1 to 4 and # 13 were sounded and are good. #3 has a full length split along bottom side. #13 has a split 3/4 length in on the east end. East Abut has two caps with corbel midspan. North cap has 450mm of rot in from center over corbel. Monitor
 2015: Pier #9 (pier #6 in the 2012 W-P survey) was rebuilt with a goofy pony-pile at some time prior to 1993. This rebuild consists of 8 short piles supporting two caps, which in turn support 4 corbels, which in turn support a single cap. The whole arrangement is a hot mess of rot and decay and needs to be torn out and the pier rebuilt with full-length piles.
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes

 2019: no observed changes

13 . Corbels

2013: Bent 8 (pier 1) Corbel blocks at top of bent 8 in good condition; Bent 9 corbels on top caps in good condition; Bent 10 corbels at water level have rot starting in the west end
 2014: no observed changes
 2015: the corbels in Pier#9 are all rotten
 2016: ground access only. no observed changes
 2017: no observed changes
 2018: no observed changes

 2019: same

14 . Dolphins/Fenders

2003: See underwater inspection report
 2004: addressed the worst condition fender piles at the north end of Pier 8 by installing 2 new piles
 2012: lots of marine growth
 2013: fender planks generally in good condition but with extensive marine growth on the planks in the water; fender piles on bents 8 and 9 have top rot; extensive marine growth at the bottom of the piles in the wetted area
 2014: no access this inspection
 2015: there are 36 fender piles and 10 of them are rotten and need replacing
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes

 2019: same

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Item Notes:

16 . Stringers

prior 2002: First four spans from south abutment have sig. rot at ends of stringers, caps have been cleated to provide more bearing area
 2002: Access. (New stringers)
 2003: all new in last eight years
 2012: no observed concerns
 2013: stringers in good condition; Span 1 is 9 treated timber stringers 400 deep by 150 wide; Span 2 to 8 are 9 treated timber stringers 400 deep by 200 wide; Span 9 is 6 steel stringers with minor corrosion on the top and bottom flanges; Span 10 is 8 treated timber stringers 400 deep by 200 wide; Span 11 & 12 are 9 treated timber stringers 400 deep by 200 wide; Span 13 is 10 treated timber stringers 400 deep by 200 wide; Span 14 is 12 treated timber stringers 400 deep by 200 wide
 2014: THIS COMPONENT NOW ONLY REFERS TO THE WOODEN STRINGERS. THE STEEL GIRDERS WILL BE TRACKED IN LINE 17. No observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns

 2019: no observed concerns

17 . Girders

2014: THIS COMPONENT IS FOR THE STEEL GIRDERS ONLY. WOODEN STRINGERS ARE IN LINE 16. No access this inspection
 2015: no access this inspection
 2016: no access this inspection
 2017: no access this inspection
 2018: Snooper inspection. flake corrosion along all girder flanges. MC to scour and apply corrosion inhibitor by 2023

 2019: no access this inspection

19 . Bracing/Diaphragms

2002: Access. (Some braces starting to rot)
 2003: Some poor sections
 2004: 12 new braces installed this year
 2012: heavy marine growth below HWM and one south brace showing decay. MC notified
 2013: bracing between the bents in good condition; timber diaphragms between the steel stringers with tension rods to hold them tight
 2014: no observed concerns
 2015: pocket rot in east brace, between Piers #3 and #4. bracing below HWM on Piers #7 and #9 are rotten
 2016: marine growth below HWM removed last summer
 2017: marine growth will require another scraping in 2018
 2018: no observed changes

 2019: new bracing added and marine growth scraped last month. no observed concerns

28 . Live Load Vibration

2012: significant vibration felt with passenger cars
 2013: long piles with small diameter and only 4 piles on most bents allows movement; pile bracing and bracing between the bents helps but there was still excessive movement under the Snooper loading
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed changes

 2019: no observed changes

30 . Sub Deck/Cross Ties

2013: Treated crossties in good condition
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: crossties set over girder stiffeners were 90-degree notched during installation, resulting in grain shear failure at notches. MC notified to replace these crossties during next deck replacement

 2019: no observed changes

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Item Notes:

31 . Wearing Surface

2005: several planks have poor ends due to rot
 2006: same comment as 2005, worst planks have been replaced
 2007: several planks are at end of lifespan one has broken end that will need a repair prior to redeck this June 2008: chip seal worn off in wheeltracks
 2009: chip seal worn off in wheel tracks
 2010: chip seal was redone this year and is wearing in several areas
 2011: same
 2012: chipwear and rutting evident throughout. south end chip worn away to planks. MC notified (see photos)
 2013: chipseal over untreated deck planks; wear and exposed planks in wheelpaths; cracks in the chip seal; extensive cracking and missing chip seal at the east end
 2014: no change. MC to spray patch and level entire surface this summer
 2014js: Work completed on Oct 22, 2014
 2015: deck planks sounded with no observed concerns. chip surface uneven
 2016: chip gone in numerous spots, chip deformed and pushed in others. MC notified
 2017: no observed changes
 2018: no observed concerns

 2019: minor chip wear. no observed concerns

33 . Curbs/Wheelguards

2007: a couple of locations have sig. rot at ends
 2008: approx 50% of wheelguard poor
 2012: curbs all solid with good paint
 2013: painted wheelguards in good condition
 2014: no observed concerns
 2015: all curbs & risers sounded. no observed concerns
 2016: no observed concerns
 2017: no observed concerns
 2018: no observed concerns

 2019: same

35 . Railings/Parapets

2005: wheelguard starting to go soft due to rot in some localized areas, one section on north side that has checks is soft throughout.
 2012: minor warping of some railing caps. MC notified
 2013: numerous top rail boards have warped with small random areas of rot in the top rail board; rails and posts are treated by not painted
 2014: no change. MC notified to replace rotten boards
 2015: rot in two railing caps on west side and 4 railing caps on east side; rot in 1 railing horizontal on west side & 3 railing horizontals on east side
 2016: same. MC to action this summer
 2017: railing components replaced last summer. No observed concerns
 2018: no observed concerns

 2019: no observed concerns

39 . Signing/Lighting

2013: West approach W54's on the ends of the flares and at the ends of the bridge; East approach W54's at the ends of the bridge only
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns

 2019: no observed concerns

40 . Roadway Approaches

2013: Approaches level with the ends of the deck; transverse crack in the asphalt at the west approach
 2014: approaches to be spray-patched as part of the deck spray this summer
 2015: no observed concerns
 2016: no observed concerns
 2017: no observed concerns
 2018: no observed concerns

 2019: same

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Item Notes:

41 . Roadway Flares

2013: 7m long flares at all 4 corners; approach speed is 50km; flares are not attached to the ends of the bridge; the flares at the west end of the bridge do not protect the end of the railings

2014: no observed concerns

2015: no observed concerns

2016: no observed concerns

2017: same

2018: no observed concerns

2019: no observed concerns

Inspection Notes:**General Inspection Notes**

2006: This bridge requires underwater inspection every 5 years and has a history of requiring replacement piles to be driven. considerable repairs were conducted in the early nineties. superstructur should be good till mid 2010 decade but pilings will need close inspection and regular replacements due to marine borers.

2018: snooper inspection

2019: BMIS glitchy and not allowing new inspection photos to be uploaded

Posted Weight Restriction

Bridge load limit 23,000 kg Tridem axle.

Drainage Area Description

2004 SCOUR OF SOUTH BANK HAS CAUSED PROBLEMS AT BRIDGE, PIER 5 HAS SETTLED AND NEEDED NEW PILES

2003: Tidal channel, scour at south Pender bank, south side, gradual. AND JACKING UP .

2002: Tidal, scour at south side, not a problem yet.

prior 2002: Tidal canal - navigation channel high usage. ocean channel between pender island.

Rehab Work Notes

2013: secure the flares to the ends of the bridge

PLACE ON REHAB. PROGRAM, REPLACE PRIOR TO NEED FOR NEXT MAJOR MAINTENANCE PROJECT.

2016: SCR JEllema has begun redesign work to replace the wetted Bents with poured concrete piers to above the HWM. From there, the bents will be retrofitted as trestles

2017: McElhanney WONG completed initial site visit May 2017 as part of the rehab project

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
- Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Inspection Notes:**Maintenance Work Notes**

prior 2002: Monitor closely, schedule south span stringer replacement, determine repairs to underwater pilings
2002: Bridge repairs, decide whether to repair or remove old Pier 8 frame
2003: Schedule pile and bracing repairs, divers shimmed pile at pier 6 on bedrock with woodpin shims I provided. Needs a more permanent repair
2004: Extensive repairs this year, need to continue monitoring and maintenance as required
2005: need to redeck in 2006 and replace a few planks to maintain for the winter 05,06 season
2007: redeck this year, June
2008: replace poor wheelguard, conduct detailed inspection and clean marine growth off of substructure. repair chip seal
2009: do detailed inspection re-chipseal
2010: patch chip seal
2011: clean up chips from deck, conduct boat and man basket inspection next year
2012: MC to rechip the deck, clean marine growth and replace the rotted brace. Snooper scheduled for 2013
2013: chipseal the deck; secure the vertical post in Bent 1; clean the marine growth off the piles; replace the corbels at the bottom of Bent 10
2014: replace rotten railing plies; band US pile on Bent 11; replace corbels & sheathing on Bent 10; spray patch and level deck
2015: major pile/brace replacement project planned for January 2016
2016: pile & brace replacement superceded by SCR rehab plan. Replace rotten railing components, recify deck condition

2018: remove LOD from Bents 9 and 10; scour and apply corrosion inhibitor to girder flanges; replace broken crossties next redeck

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
 - Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

RFI: 01-B-P-00470 - Canal Road - ON

Features Crossed: CANAL / BROWNING HBR

Component Group/Component		E	G	F	P	V	X	N/A
HYDROTECHNICAL :								
1.	Debris Risk			100				N
2.	Channel		100					N
3.	Erosion Protection		100					N
4.	Substructure Scour			100				N
SUBSTRUCTURE :								
5.	Foundation Movement		100					N
6.	Abutments		95	5				N
7.	Wing/Retaining Walls		100					N
8.	Embankment		100					N
9.	Footings/Piling		50	15	10	25		N
11.	Bearings		100					N
12.	Caps			97	3			N
13.	Corbels		90			10		N
14.	Dolphins/Fenders			55		45		N
SUPERSTRUCTURE :								
16.	Stringers		100					N
17.	Girders		90	10				N
19.	Bracing/Diaphragms		100					N
28.	Live Load Vibration		100					N
DECK :								
30.	Sub Deck/Cross Ties		95		5			N
31.	Wearing Surface			90		10		N
33.	Curbs/Wheelguards		90	10				N
35.	Railings/Parapets		100					N
APPROACHES :								
39.	Signing/Lighting		100					N
40.	Roadway Approaches		100					N
41.	Roadway Flares		100					N

1st Abutment Position: W

Year Built: 1955 Estimated? ☐

Length (m): 90.900

Note: The first abutment is West which is on the North Pender end. The East abutment is at the widened end of the bridge.

Main Span Length: 15.300

Main Span Type: STRINGER

Spans: 14

Urgency: 3

BCI Rating: 2.28

Adjusted BCI Rating: 2.39

Inspector/Inspected By: Jeff Ray

On 2021/04/13

Amendment/Partial Inspection?

Urgency Notes:

Urgency Rating Note: Rot in the corbels at water level on pier 10
 Flares not attached to the ends of the bridge
 Underwatering inspection of the piles

Item Notes:

- 1 . Debris Risk

2013: No debris noted at the time of the inspection
 2018: LOD hung up on Bents 9 and 10, MC notified
 2019: LOD removed last summer. No observed concerns

 2021: no observed concerns
- 2 . Channel

2013: Ocean channel between the north and south islands; Skew is straight under the bridge; Banks are solid rock both sides; Bed is solid; Adequacy is good at main span in number 9 where boats pass through
 2016: vessel height clearance under the structure is posted for 9.03m
 2017: horizontal channel clearance needed
 2021: no observed concerns
- 3 . Erosion Protection

2013: Small rock retaining wall on the east side of bent 5 has some erosion under the south end of the wall
 2021: no observed changes

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
 - Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- | | |
|--------------------------|---|
| 4 . Substructure Scour | 2002: South Pender bank scouring, not affecting bridge.
2003: Bank scour beside south Pender bank not a problem yet
2004: Bank scour on the south Pender bank has created problems, the first bent is in the intertidal zone and has settled. New piles have been driven at this location to address the problem.
2008: some minor scour under the rock wall on the north pender side
2010: same
2012: photos taken of north side rock wall scour. continue to monitor
2013: erosion under the sound end of the rock retaining wall on the east side of Bent 5; dirt on both banks is being eroded off the base rock
2020: Culvert on south pender needs to be replaced as it is rotten and causing erosion to pile on pier 12 |
| 5 . Foundation Movement | 2011: 1st pier in water on south pender side settled in 2004 and new piles had to be driven. stable since then but need to monitor
2012: continue to monitor
2013: no movement noted at the time of the inspection
2021: no observed concerns |
| 6 . Abutments | 2013: West abutment (north Pender side) has concrete footing and 100 by 310 creosoted timber planks in good condition; East abutment has 100 by 400 treated ballast planks in good condition
2014: no observed concerns
2015: south abut ("east" on design cap is sectioned and one section has rot. Cap to be replaced with one single timber
2016: south (east) abutment cap replaced last summer.
2019: East Abut/Pile 5 (from U/S) has developed a 1/8" gap between the pile top and the cap. MC notified and instructed to tie the pile to the cap with vertical fishplate.

2020: tie completed last summer. rot observed in East Abut jump cap
2021: nmo observed changes |
| 7 . Wing/Retaining Walls | 2013: Short extensions of the abutment ballast planks
2021: no observed concerns |
| 8 . Embankment | 2013: No embankment scour noted at the time of the inspection
2020: Culvert on south pender needs to be replaced as it is rotten and causing erosion to pile on pier 12 |

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

9 . Footings/Piling

prior 2002: detailed inspection from 1999 in bridge file

2002: Access

2003: See underwater report - redundancy check shows no immediate concern

2004: several new pilings installed; Pier 8 had underwater repair to non functioning pile that was located on boulder (rock dowells and tremied concrete at the base of the pile); 4 additional piles driven at pier 8; pier 5 had several piles driven to address recent settlement. Details of the 2004 piling repairs are in the bridge files; 2003 underwater inspections marked up to reflect new work

2008: 2 piles on 4th pier from north side sound hollow approx 1.0 m. above ground el.

2010: pier 4 from north pender end has an interior pile that sounds hollow, marked with blue paint

2012: north east footing #1 sounds hollow. marked with red X and photo; Two bents on Pier #2 (from north) are barnacled but well above HWM. Were these salvaged from somewhere? (photos taken); Mid-span piers have a lot of marine growth (photos)

2013: Snooper inspection but unable to tap most piles because of the cross bracing between the bents; tops of piles checked and okay; heavy marine growth on the piles in the water; West abutment concrete footing in good condtion; Bent 1 is Pony bent concrete footing; tapped 2nd vertical at the top and it is loose with one 3-inch nail appears to be all that holds it in place; Bent 2 have barnacles on piles 2A and 2B even though the bent is above high water and a short 300 by 300 creosoted block added on top of pile 2B; Bent 4 has 2 by 4's and strapping added at the bottom of pile 4C appears to be to stop checks from spreading; Bents 2 to 7 have 4 creostoed timber piles in each; Bent 8 (pier 1) has double row of creosoted timber piles & sheathing planks on the east side and fender piles both ends with top rot in the fender piles both ends; Bent 9 (pier 2) has double row of creosoted timber piles with sheathing planks on the west side and fender piles at both ends with top rot in the fender piles; Bent 10 (pier 3) is 3 rows of creosoted timber piles and center row of piles sit on 300 by 300 creosoted timber; Bent 11 is 9 creosoted timber piles & piles 11D, 11F and 11H have timber shims at the top; Bent 12 is 4 creosoted timber piles; Bent 14 is 5 creosoted timber piles; Pile bracing along the piles and crossbracing between the bents

2014: US pile on Bent 11 (photo) needs banding. MC notified

2014js: Inspected by Regional team with extension ladder. Piers 1 to 4 and # 13 were sounded full length and are good condition. First 2.5m on all other land piles were sounded and are good. BAM note from early 2014 inspection as well.

2015: the Worley-Parsons dive survey from 2012 was "rediscovered" this winter and it identified a number of piles for replacement. The piles it identified have now been marked in the field with orange paint. Note that the W-P dive survey used the East (south island) abutment as 1st, so their pier count is backwards. Pier #9 (pier#6 in the W-P report) was rebuilt, at some time prior to 1993, with a pony-pier arrangment consisting of 8 short piles supporting two caps,, which in tuurn support 4 corbels, which in turn support a single cap, which in turn supports 4 trestle-piles. The whole configuration is rotten and needs to be torn out & replaced with full length piles.

2020rbi: Bent1 column A&C showing crushing, column B not supporting any weight (requires shims)

2021: shims installed

11 . Bearings

2013: Full width steel plates welded to the bottoms of the stringers at both ends of span 9

2018: Snooper Inspection, no observed concerns

2021: no access this inspection

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

Condition Inspection Report

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

12 . Caps

2002: New caps
 2003 (and 2002): Access
 2011: south pender abut cap starting to sound a bit soft, drill next inspection
 2012: schedule drill for 2013
 2013: most of the caps were accessed by Snooper but not able to tap full length due to the crossbracing between the bents; 300 by 300 creosoted timber caps at both abutments; treated caps on approach spans both ends; creosoted timber caps on piers 1 and 2; Bent 10 double treated caps 300 by 300 on the west side; 3 treated caps 200 by 200 on the east side
 2014: no access from ground
 2014js: Inspected by Regional team with extension ladder. Caps on Piers 1 to 4 and # 13 were sounded and are good. #3 has a full length split along bottom side. #13 has a split 3/4 length in on the east end. East Abut has two caps with corbel midspan. North cap has 450mm of rot in from center over corbel. Monitor
 2015: Pier #9 (pier #6 in the 2012 W-P survey) was rebuilt with a goofy pony-pile at some time prior to 1993. This rebuild consists of 8 short piles supporting two caps, which in turn support 4 corbels, which in turn support a single cap. The whole arrangement is a hot mess of rot and decay and needs to be torn out and the pier rebuilt with full-length piles.
 2020: east abut jump cap has rot developing
 2020rbi: east abut cap has rot in center both pieces
 2021: no observed changes

13 . Corbels

2013: Bent 8 (pier 1) Corbel blocks at top of bent 8 in good condition; Bent 9 corbels on top caps in good condition; Bent 10 corbels at water level have rot starting in the west end
 2015: the corbels in Pier#9 are all rotten
 2021: ground access only. no observed changes

14 . Dolphins/Fenders

2003: See underwater inspection report
 2004: addressed the worst condition fender piles at the north end of Pier 8 by installing 2 new piles
 2012: lots of marine growth
 2013: fender planks generally in good condition but with extensive marine growth on the planks in the water; fender piles on bents 8 and 9 have top rot; extensive marine growth at the bottom of the piles in the wetted area
 2014: no access this inspection
 2015: there are 36 fender piles and 10 of them are rotten and need replacing
 2021: no observed changes

16 . Stringers

prior 2002: First four spans from south abutment have sig. rot at ends of stringers, caps have been cleated to provide more bearing area
 2002: Access. (New stringers)
 2003: all new in last eight years
 2012: no observed concerns
 2013: stringers in good condition; Span 1 is 9 treated timber stringers 400 deep by 150 wide; Span 2 to 8 are 9 treated timber stringers 400 deep by 200 wide; Span 9 is 6 steel stringers with minor corrosion on the top and bottom flanges; Span 10 is 8 treated timber stringers 400 deep by 200 wide; Span 11 & 12 are 9 treated timber stringers 400 deep by 200 wide; Span 13 is 10 treated timber stringers 400 deep by 200 wide; Span 14 is 12 treated timber stringers 400 deep by 200 wide
 2014: THIS COMPONENT NOW ONLY REFERS TO THE WOODEN STRINGERS. THE STEEL GIRDERS WILL BE TRACKED IN LINE 17.
 2021: no observed concerns

17 . Girders

2014: THIS COMPONENT IS FOR THE STEEL GIRDERS ONLY. WOODEN STRINGERS ARE IN LINE 16. No access this inspection
 2018: Snooper inspection. flake corrosion along all girder flanges. MC to scour and apply corrosion inhibitor by 2023
 2021: no access this inspection

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

ALFREDHO

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- | | |
|--------------------------|--|
| 19 . Bracing/Diaphragms | 2002: Access. (Some braces starting to rot)
2003: Some poor sections
2004: 12 new braces installed this year
2012: heavy marine growth below HWM and one south brace showing decay. MC notified
2013: bracing between the bents in good condition; timber diaphragms between the steel stringers with tension rods to hold them tight
2014: no observed concerns
2015: pocket rot in east brace, between Piers #3 and #4. bracing below HWM on Piers #7 and #9 are rotten
2016: marine growth below HWM removed last summer
2017: marine growth will require another scraping in 2018
2019: new bracing added and marine growth scraped last month.
2021: marine growth needs removing |
| 28 . Live Load Vibration | 2012: significant vibration felt with passenger cars
2013: long piles with small diameter and only 4 piles on most bents allows movement; pile bracing and bracing between the bents helps but there was still excessive movement under the Snooper loading
2021: no observed changes |
| 30 . Sub Deck/Cross Ties | 2013: Treated crossties in good condition
2018: crossties set over girder stiffeners were 90-degree notched during installation, resulting in grain shear failure at notches. MC notified to replace these crossties during next deck replacement
2021: no observed changes |
| 31 . Wearing Surface | 2005: several planks have poor ends due to rot
2006: same comment as 2005, worst planks have been replaced
2007: several planks are at end of lifespan one has broken end that will need a repair prior to redeck this June 2008: chip seal worn off in wheeltracks
2009: chip seal worn off in wheel tracks
2010: chip seal was redone this year and is wearing in several areas
2011: same
2012: chipwear and rutting evident throughout. south end chip worn away to planks. MC notified (see photos)
2013: chipseal over untreated deck planks; wear and exposed planks in wheelpaths; cracks in the chip seal; extensive cracking and missing chip seal at the east end
2014: no change. MC to spray patch and level entire surface this summer
2014js: Work completed on Oct 22, 2014
2015: deck planks sounded with no observed concerns. chip surface uneven
2016: chip gone in numerous spots, chip deformed and pushed in others. MC notified
2017: no observed changes
2018: no observed concerns
2019: minor chip wear. no observed concerns
2020rbi: exposed deck planks in good condition. Chip failing in spots
2021: some deck plank replaced - chip continues to fail |
| 33 . Curbs/Wheelguards | 2007: a couple of locations have sig. rot at ends
2008: approx 50% of wheelguard poor
2012: curbs all solid with good paint
2013: painted wheelguards in good condition
2014: no observed concerns
2015: all curbs & risers sounded. no observed concerns
2021: no observed concerns |
| 35 . Railings/Parapets | 2005: wheelguard starting to go soft due to rot in some localized areas, one section on north side that has checks is soft throughout.
2012: minor warping of some railing caps. MC notified
2013: numerous top rail boards have warped with small random areas of rot in the top rail board; rails and posts are treated by not painted
2014: no change. MC notified to replace rotten boards
2015: rot in two railing caps on west side and 4 railing caps on east side; rot in 1 railing horizontal on west side & 3 railing horizontals on east side
2016: same. MC to action this summer
2017: railing components replaced last summer. No observed concerns
2021: no observed concerns |

BRIDGE MANAGEMENT INFORMATION SYSTEM

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- | | |
|--------------------------------|---|
| 39 . Signing/Lighting | 2013: West approach W54's on the ends of the flares and at the ends of the bridge; East approach W54's at the ends of the bridge only
2021: no observed concerns |
| 40 . Roadway Approaches | 2013: Approaches level with the ends of the deck; transverse crack in the asphalt at the west approach
2014: approaches to be spray-patched as part of the deck spray this summer
2021: no observed concerns |
| 41 . Roadway Flares | 2013: 7m long flares at all 4 corners; approach speed is 50km; flares are not attached to the ends of the bridge; the flares at the west end of the bridge do not protect the end of the railings
2021: no observed concerns |

Inspection Notes:**General Inspection Notes**

2006: This bridge requires underwater inspection every 5 years and has a history of requiring replacement piles to be driven. considerable repairs were conducted in the early nineties. superstructure should be good till mid 2010 decade but pilings will need close inspection and regular replacements due to marine borers.

2018: snoop inspection

2019: BMIS glitchy and not allowing new inspection photos to be uploaded

2020rbi: Inspected by RBI's

Posted Weight Restriction

Bridge load limit 23,000 kg Tridem axle.

Drainage Area Description

2004 SCOUR OF SOUTH BANK HAS CAUSED PROBLEMS AT BRIDGE, PIER 5 HAS SETTLED AND NEEDED NEW PILES

2003: Tidal channel, scour at south Pender bank, south side, gradual. AND JACKING UP .

2002: Tidal, scour at south side, not a problem yet.

prior 2002: Tidal canal - navigation channel high usage. ocean channel between pender island.

Rehab Work Notes

2013: secure the flares to the ends of the bridge

PLACE ON REHAB. PROGRAM, REPLACE PRIOR TO NEED FOR NEXT MAJOR MAINTENANCE PROJECT.

2016: SCR JEllema has begun redesign work to replace the wetted Bents with poured concrete piers to above the HWM. From there, the bents will be retrofitted as trestles

2017: McElhanney WONG completed initial site visit May 2017 as part of the rehab project

BRIDGE MANAGEMENT INFORMATION SYSTEM

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Inspection Notes:**Maintenance Work Notes**

prior 2002: Monitor closely, schedule south span stringer replacement, determine repairs to underwater pilings
 2002: Bridge repairs, decide whether to repair or remove old Pier 8 frame
 2003: Schedule pile and bracing repairs, divers shimmed pile at pier 6 on bedrock with woodpin shims I provided. Needs a more permanent repair
 2004: Extensive repairs this year, need to continue monitoring and maintenance as required
 2005: need to redeck in 2006 and replace a few planks to maintain for the winter 05,06 season
 2007: redeck this year, June
 2008: replace poor wheelguard, conduct detailed inspection and clean marine growth off of substructure. repair chip seal
 2009: do detailed inspection re-chipseal
 2010: patch chip seal
 2011: clean up chips from deck, conduct boat and man basket inspection next year
 2012: MC to rechip the deck, clean marine growth and replace the rotted brace. Snooper scheduled for 2013
 2013: chipseal the deck; secure the vertical post in Bent 1; clean the marine growth off the piles; replace the corbels at the bottom of Bent 10
 2014: replace rotten railing plies; band US pile on Bent 11; replace corbels & sheathing on Bent 10; spray patch and level deck
 2015: major pile/brace replacement project planned for January 2016
 2016: pile & brace replacement superceded by SCR rehab plan. Replace rotten railing components, recify deck condition

 2018: remove LOD from Bents 9 and 10; scour and apply corrosion inhibitor to girder flanges; replace broken crossties next redeck
 2021: South abut - install steel straps between adjacent pile caps and corbel blocks - possible rechip in 2022. Discuss with SCR Ho regarding their plan and response to 2021Feb McElhanney report

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

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Condition Inspection Report

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

RFI: 01-B-P-00470 - Canal Road - ON

Features Crossed: CANAL / BROWNING HBR

Component Group/Component		E	G	F	P	V	X	N/A
HYDROTECHNICAL :								
1.	Debris Risk			100				N
2.	Channel		100					N
3.	Erosion Protection		100					N
4.	Substructure Scour			100				N
SUBSTRUCTURE :								
5.	Foundation Movement		100					N
6.	Abutments		95	5				N
7.	Wing/Retaining Walls		100					N
8.	Embankment		100					N
9.	Footings/Piling		50	15	10	25		N
11.	Bearings		100					N
12.	Caps			100				N
13.	Corbels		90			10		N
14.	Dolphins/Fenders			55		45		N
SUPERSTRUCTURE :								
16.	Stringers		100					N
17.	Girders		90	10				N
19.	Bracing/Diaphragms		100					N
28.	Live Load Vibration		100					N
DECK :								
30.	Sub Deck/Cross Ties		95		5			N
31.	Wearing Surface			100				N
33.	Curbs/Wheelguards		100					N
35.	Railings/Parapets		100					N
APPROACHES :								
39.	Signing/Lighting		100					N
40.	Roadway Approaches		100					N
41.	Roadway Flares		100					N

1st Abutment Position: W

Year Built: 1955 Estimated? ☐

Length (m): 90.900

Note: The first abutment is West which is on the North Pender end. The East abutment is at the widened end of the bridge.

Main Span Length: 15.300

Main Span Type: STRINGER

Spans: 14

Urgency: 3

BCI Rating: 2.26

Adjusted BCI Rating: 2.38

Inspector/Inspected By: CHRISTOPHER GORD

On 2020/04/21

Amendment/Partial Inspection?

Urgency Notes:

Urgency Rating Note: Rot in the corbels at water level on pier 10
 Flares not attached to the ends of the bridge
 Underwatering inspection of the piles

Item Notes:

1 . Debris Risk

2013: No debris noted at the time of the inspection

2014: no observed concerns

2015: no observed concerns

2016: no observed concerns

2017: same

2018: LOD hung up on Bents 9 and 10, MC notified

2019: LOD removed last summer. No observed concerns

2020: no observed concerns

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 2 . Channel
- 2013: Ocean channel between the north and south islands; Skew is straight under the bridge; Banks are solid rock both sides; Bed is solid; Adequacy is good at main span in number 9 where boats pass through
 2014: no observed concerns
 2015: no observed concerns
 2016: vessel height clearance under the structure is posted for 9.03m
 2017: horizontal channel clearance needed
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 3 . Erosion Protection
- 2013: Small rock retaining wall on the east side of bent 5 has some erosion under the south end of the wall
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 4 . Substructure Scour
- 2002: South Pender bank scouring, not affecting bridge.
 2003: Bank scour beside south Pender bank not a problem yet
 2004: Bank scour on the south Pender bank has created problems, the first bent is in the intertidal zone and has settled. New piles have been driven at this location to address the problem.
 2008: some minor scour under the rock wall on the north pender side
 2010: same
 2012: photos taken of north side rock wall scour. continue to monitor
 2013: erosion under the sound end of the rock retaining wall on the east side of Bent 5; dirt on both banks is being eroded off the base rock
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 5 . Foundation Movement
- 2011: 1st pier in water on south pender side settled in 2004 and new piles had to be driven. stable since then but need to monitor
 2012: continue to monitor
 2013: no movement noted at the time of the inspection
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 6 . Abutments
- 2013: West abutment (north Pender side) has concrete footing and 100 by 310 creosoted timber planks in good condition; East abutment has 100 by 400 treated ballast planks in good condition
 2014: no observed concerns
 2015: south abut ("east" on design cap is sectioned and one section has rot. Cap to be replaced with one single timber
 2016: south (east) abutment cap replaced last summer. no observed concerns
 2017: no observed concerns
 2018: no observed concerns
 2019: East Abut/Pile 5 (from U/S) has developed a 1/8" gap between the pile top and the cap. MC notified and instructed to tie the pile to the cap with vertical fishplate.

 2020: tie completed last summer. rot observed in East Abut jump cap

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

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Condition Inspection Report

Criteria: Structure No = 06880 - Include Inspection Condition Photos = N
 - Include Additional Blank Lines for Notes = N - Show Not Applicable Components = N

Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 7 . Wing/Retaining Walls 2013: Short extensions of the abutment ballast planks
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 8 . Embankment 2013: No embankment scour noted at the time of the inspection
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 9 . Footings/Piling prior 2002: detailed inspection from 1999 in bridge file
 2002: Access
 2003: See underwater report - redundancy check shows no immediate concern
 2004: several new pilings installed; Pier 8 had underwater repair to non functioning pile that was located on boulder (rock dowells and tremied concrete at the base of the pile); 4 additional piles driven at pier 8; pier 5 had several piles driven to address recent settlement. Details of the 2004 piling repairs are in the bridge files; 2003 underwater inspections marked up to reflect new work
 2008: 2 piles on 4th pier from north side sound hollow approx 1.0 m. above ground el.
 2010: pier 4 from north pender end has an interior pile that sounds hollow, marked with blue paint
 2012: north east footing #1 sounds hollow. marked with red X and photo; Two bents on Pier #2 (from north) are barnacled but well above HWM. Were these salvaged from somewhere? (photos taken); Mid-span piers have a lot of marine growth (photos)
 2013: Snooper inspection but unable to tap most piles because of the cross bracing between the bents; tops of piles checked and okay; heavy marine growth on the piles in the water; West abutment concrete footing in good condition; Bent 1 is Pony bent concrete footing; tapped 2nd vertical at the top and it is loose with one 3-inch nail appears to be all that holds it in place; Bent 2 have barnacles on piles 2A and 2B even though the bent is above high water and a short 300 by 300 creosoted block added on top of pile 2B; Bent 4 has 2 by 4's and strapping added at the bottom of pile 4C appears to be to stop checks from spreading; Bents 2 to 7 have 4 creosoted timber piles in each; Bent 8 (pier 1) has double row of creosoted timber piles & sheathing planks on the east side and fender piles both ends with top rot in the fender piles both ends; Bent 9 (pier 2) has double row of creosoted timber piles with sheathing planks on the west side and fender piles at both ends with top rot in the fender piles; Bent 10 (pier 3) is 3 rows of creosoted timber piles and center row of piles sit on 300 by 300 creosoted timber; Bent 11 is 9 creosoted timber piles & piles 11D, 11F and 11H have timber shims at the top; Bent 12 is 4 creosoted timber piles; Bent 14 is 5 creosoted timber piles; Pile bracing along the piles and crossbracing between the bents
 2014: US pile on Bent 11 (photo) needs banding. MC notified
 2014js: Inspected by Regional team with extension ladder. Piers 1 to 4 and # 13 were sounded full length and are good condition. First 2.5m on all other land piles were sounded and are good. BAM note from early 2014 inspection as well.
 2015: the Worley-Parsons dive survey from 2012 was "rediscovered" this winter and it identified a number of piles for replacement. The piles it identified have now been marked in the field with orange paint. Note that the W-P dive survey used the East (south island) abutment as 1st, so their pier count is backwards. Pier #9 (pier#6 in the W-P report) was rebuilt, at some time prior to 1993, with a pony-pier arrangement consisting of 8 short piles supporting two caps,, which in turn support 4 corbels, which in turn support a single cap, which in turn supports 4 trestle-piles. The whole configuration is rotten and needs to be torn out & replaced with full length piles.
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: no observed changes

 2020: no observed changes

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Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

11 . Bearings

2013: Full width steel plates welded to the bottoms of the stringers at both ends of span 9
 2014: no access from ground
 2015: no access this inspection
 2016: no access this inspection
 2017: no access this inspection
 2018: Snooper Inspection, no observed concerns
 2019: no access this inspection

 2020: no access this inspection

12 . Caps

2002: New caps
 2003 (and 2002): Access
 2011: south pender abut cap starting to sound a bit soft, drill next inspection
 2012: schedule drill for 2013
 2013: most of the caps were accessed by Snooper but not able to tap full length due to the crossbracing between the bents; 300 by 300 creosoted timber caps at both abutments; treated caps on approach spans both ends; creosoted timber caps on piers 1 and 2; Bent 10 double treated caps 300 by 300 on the west side; 3 treated caps 200 by 200 on the east side
 2014: no access from ground
 2014js: Inspected by Regional team with extension ladder. Caps on Piers 1 to 4 and # 13 were sounded and are good. #3 has a full length split along bottom side. #13 has a split 3/4 length in on the east end. East Abut has two caps with corbel midspan. North cap has 450mm of rot in from center over corbel. Monitor
 2015: Pier #9 (pier #6 in the 2012 W-P survey) was rebuilt with a goofy pony-pile at some time prior to 1993. This rebuild consists of 8 short piles supporting two caps, which in turn support 4 corbels, which in turn support a single cap. The whole arrangement is a hot mess of rot and decay and needs to be torn out and the pier rebuilt with full-length piles.
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: no observed changes

 2020: east abut jump cap has rot developing

13 . Corbels

2013: Bent 8 (pier 1) Corbel blocks at top of bent 8 in good condition; Bent 9 corbels on top caps in good condition; Bent 10 corbels at water level have rot starting in the west end
 2014: no observed changes
 2015: the corbels in Pier#9 are all rotten
 2016: ground access only. no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: same

 2020: ground access only. no observed changes

14 . Dolphins/Fenders

2003: See underwater inspection report
 2004: addressed the worst condition fender piles at the north end of Pier 8 by installing 2 new piles
 2012: lots of marine growth
 2013: fender planks generally in good condition but with extensive marine growth on the planks in the water; fender piles on bents 8 and 9 have top rot; extensive marine growth at the bottom of the piles in the wetted area
 2014: no access this inspection
 2015: there are 36 fender piles and 10 of them are rotten and need replacing
 2016: no observed changes
 2017: no observed changes
 2018: no observed changes
 2019: same

 2020: no observed changes

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Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

16 . Stringers

prior 2002: First four spans from south abutment have sig. rot at ends of stringers, caps have been cleated to provide more bearing area
 2002: Access. (New stringers)
 2003: all new in last eight years
 2012: no observed concerns
 2013: stringers in good condition; Span 1 is 9 treated timber stringers 400 deep by 150 wide; Span 2 to 8 are 9 treated timber stringers 400 deep by 200 wide; Span 9 is 6 steel stringers with minor corrosion on the top and bottom flanges; Span 10 is 8 treated timber stringers 400 deep by 200 wide; Span 11 & 12 are 9 treated timber stringers 400 deep by 200 wide; Span 13 is 10 treated timber stringers 400 deep by 200 wide; Span 14 is 12 treated timber stringers 400 deep by 200 wide
 2014: THIS COMPONENT NOW ONLY REFERS TO THE WOODEN STRINGERS. THE STEEL GIRDERS WILL BE TRACKED IN LINE 17. No observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns

17 . Girders

2014: THIS COMPONENT IS FOR THE STEEL GIRDERS ONLY. WOODEN STRINGERS ARE IN LINE 16. No access this inspection
 2015: no access this inspection
 2016: no access this inspection
 2017: no access this inspection
 2018: Snooper inspection. flake corrosion along all girder flanges. MC to scour and apply corrosion inhibitor by 2023
 2019: no access this inspection

 2020: no access this inspection

19 . Bracing/Diaphragms

2002: Access. (Some braces starting to rot)
 2003: Some poor sections
 2004: 12 new braces installed this year
 2012: heavy marine growth below HWM and one south brace showing decay. MC notified
 2013: bracing between the bents in good condition; timber diaphragms between the steel stringers with tension rods to hold them tight
 2014: no observed concerns
 2015: pocket rot in east brace, between Piers #3 and #4. bracing below HWM on Piers #7 and #9 are rotten
 2016: marine growth below HWM removed last summer
 2017: marine growth will require another scraping in 2018
 2018: no observed changes
 2019: new bracing added and marine growth scraped last month. no observed concerns

 2020: marine growth needs removing

28 . Live Load Vibration

2012: significant vibration felt with passenger cars
 2013: long piles with small diameter and only 4 piles on most bents allows movement; pile bracing and bracing between the bents helps but there was still excessive movement under the Snooper loading
 2014: no observed changes
 2015: no observed changes
 2016: no observed changes
 2017: same
 2018: no observed changes
 2019: no observed changes

 2020: no observed changes

BRIDGE MANAGEMENT INFORMATION SYSTEM

14 Jun 2022

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Structure No: 06880 - CANAL

Status: Open/In Use

Inspection Type: Routine Condition

Region: 1 - South Coast Region

District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 30 . Sub Deck/Cross Ties
 2013: Treated crossties in good condition
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: crossties set over girder stiffeners were 90-degree notched during installation, resulting in grain shear failure at notches. MC notified to replace these crossties during next deck replacement
 2019: no observed changes

 2020: no observed changes
- 31 . Wearing Surface
 2005: several planks have poor ends due to rot
 2006: same comment as 2005, worst planks have been replaced
 2007: several planks are at end of lifespan one has broken end that will need a repair prior to redeck this June 2008: chip seal worn off in wheeltracks
 2009: chip seal worn off in wheel tracks
 2010: chip seal was redone this year and is wearing in several areas
 2011: same
 2012: chipwear and rutting evident throughout. south end chip worn away to planks. MC notified (see photos)
 2013: chipseal over untreated deck planks; wear and exposed planks in wheelpaths; cracks in the chip seal; extensive cracking and missing chip seal at the east end
 2014: no change. MC to spray patch and level entire surface this summer
 2014js: Work completed on Oct 22, 2014
 2015: deck planks sounded with no observed concerns. chip surface uneven
 2016: chip gone in numerous spots, chip deformed and pushed in others. MC notified
 2017: no observed changes
 2018: no observed concerns
 2019: minor chip wear. no observed concerns

 2020: no observed concerns
- 33 . Curbs/Wheelguards
 2007: a couple of locations have sig. rot at ends
 2008: approx 50% of wheelguard poor
 2012: curbs all solid with good paint
 2013: painted wheelguards in good condition
 2014: no observed concerns
 2015: all curbs & risers sounded. no observed concerns
 2016: no observed concerns
 2017: no observed concerns
 2018: no observed concerns
 2019: same

 2020: no observed concerns
- 35 . Railings/Parapets
 2005: wheelguard starting to go soft due to rot in some localized areas, one section on north side that has checks is soft throughout.
 2012: minor warping of some railing caps. MC notified
 2013: numerous top rail boards have warped with small random areas of rot in the top rail board; rails and posts are treated by not painted
 2014: no change. MC notified to replace rotten boards
 2015: rot in two railing caps on west side and 4 railing caps on east side; rot in 1 railing horizontal on west side & 3 railing horizontals on east side
 2016: same. MC to action this summer
 2017: railing components replaced last summer. No observed concerns
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns

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Inspection Type: Routine Condition

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District: 2 - Vancouver Island District

Contract Area: 1 - South Island CA

Item Notes:

- 39 . Signing/Lighting 2013: West approach W54's on the ends of the flares and at the ends of the bridge; East approach W54's at the ends of the bridge only
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns
- 40 . Roadway Approaches 2013: Approaches level with the ends of the deck; transverse crack in the asphalt at the west approach
 2014: approaches to be spray-patched as part of the deck spray this summer
 2015: no observed concerns
 2016: no observed concerns
 2017: no observed concerns
 2018: no observed concerns
 2019: same

 2020: no observed concerns
- 41 . Roadway Flares 2013: 7m long flares at all 4 corners; approach speed is 50km; flares are not attached to the ends of the bridge; the flares at the west end of the bridge do not protect the end of the railings
 2014: no observed concerns
 2015: no observed concerns
 2016: no observed concerns
 2017: same
 2018: no observed concerns
 2019: no observed concerns

 2020: no observed concerns

Inspection Notes:**General Inspection Notes**

2006: This bridge requires underwater inspection every 5 years and has a history of requiring replacement piles to be driven. considerable repairs were conducted in the early nineties. superstructure should be good till mid 2010 decade but pilings will need close inspection and regular replacements due to marine borers.

2018: snooper inspection

2019: BMIS glitchy and not allowing new inspection photos to be uploaded

Posted Weight Restriction

Bridge load limit 23,000 kg Tridem axle.

Drainage Area Description

2004 SCOUR OF SOUTH BANK HAS CAUSED PROBLEMS AT BRIDGE, PIER 5 HAS SETTLED AND NEEDED NEW PILES

2003: Tidal channel, scour at south Pender bank, south side, gradual. AND JACKING UP .

2002: Tidal, scour at south side, not a problem yet.

prior 2002: Tidal canal - navigation channel high usage. ocean channel between pender island.

Rehab Work Notes

2013: secure the flares to the ends of the bridge

PLACE ON REHAB. PROGRAM, REPLACE PRIOR TO NEED FOR NEXT MAJOR MAINTENANCE PROJECT.

2016: SCR Jellema has begun redesign work to replace the wetted Bents with poured concrete piers to above the HWM. From there, the bents will be retrofitted as trestles

2017: McElhanney WONG completed initial site visit May 2017 as part of the rehab project

BRIDGE MANAGEMENT INFORMATION SYSTEM

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District: 2 - Vancouver Island District

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Inspection Notes:**Maintenance Work Notes**

prior 2002: Monitor closely, schedule south span stringer replacement, determine repairs to underwater pilings

2002: Bridge repairs, decide whether to repair or remove old Pier 8 frame

2003: Schedule pile and bracing repairs, divers shimmed pile at pier 6 on bedrock with woodpin shims I provided. Needs a more permanent repair

2004: Extensive repairs this year, need to continue monitoring and maintenance as required

2005: need to redeck in 2006 and replace a few planks to maintain for the winter 05,06 season

2007: redeck this year, June

2008: replace poor wheelguard, conduct detailed inspection and clean marine growth off of substructure. repair chip seal

2009: do detailed inspection re-chipseal

2010: patch chip seal

2011: clean up chips from deck, conduct boat and man basket inspection next year

2012: MC to rechip the deck, clean marine growth and replace the rotted brace. Snooper scheduled for 2013

2013: chipseal the deck; secure the vertical post in Bent 1; clean the marine growth off the piles; replace the corbels at the bottom of Bent 10

2014: replace rotten railing plies; band US pile on Bent 11; replace corbels & sheathing on Bent 10; spray patch and level deck

2015: major pile/brace replacement project planned for January 2016

2016: pile & brace replacement superceded by SCR rehab plan. Replace rotten railing components, recify deck condition

2018: remove LOD from Bents 9 and 10; scour and apply corrosion inhibitor to girder flanges; replace broken crossties next redeck



MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

Pender Island Canal Bridge No. 6880 Inspection

307071-00580 – 00-MA-REP-0001

26 March 2012

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MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
PENDER ISLAND CANAL BRIDGE NO. 6880 INSPECTION

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PROJECT 307071-00580 - PENDER ISLAND CANAL BRIDGE NO. 6880 INSPECTION

REV	DESCRIPTION	ORIG	REVIEW	WORLEY- PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issued for Use	S. Bethune	M. Ramsden	M. Ramsden	#1-c 2 ar-12		

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Appendices

APPENDIX 1	PHOTOGRAPHS	
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1. INTRODUCTION

Facility: Canal Bridge No. 6880, Pender Island, BC

Inspected by: WorleyParsons Canada Services Ltd. (WorleyParsons): Carla McGregor, P.Eng.

Shawn Bethune, E.I.T.

Alan Love

Date: March 20, 2012

1.1 Purpose of Inspection

The purpose of the inspection is to carry out a detailed condition assessment of the below water substructure elements of Canal Bridge No. 6880 on Pender Island, BC. This inspection will develop a current database of the condition of the timber piles, cross-bracing, and horizontal sheeting timbers below the waterline. Based on the inspection results, a prioritized program of repairs and maintenance work can be implemented.

1.2 Scope of Work

The scope of work is summarized below:

- A Level I visual below water condition assessment of the timber piles, cross-bracing, and horizontal sheeting timbers.
- A Level II inspection at five locations on the submerged portion of the bearing piles.
- The preparation of a report presenting the inspection findings, recommendations for repairs, residual life estimates, and approximate replacement values.

To assist the Ministry of Transportation and Infrastructure (MTI) in evaluating the significance of the recommendations, the estimated cost to implement the recommendations, and the remaining service life of the various structures, will also be prepared.

1.3 Reference Material

The following reference material was made available prior to the inspection:

- Foreshore Technologies Inc. Drawing No. 2604-MOT.
- Foreshore Technologies Inc. report dated March 13, 2003 and titled "Inspection of Canal Bridge No. 6880".



1.4 Evaluation of Results

The inspection, related findings, and recommendations are based on the following:

- The scope of work outlined in Section 1.2.
- Published recommendations and standards relating to structures of this type have been used as a guide to develop the scope of work for this inspection.
- Original construction drawings, record drawings, specifications, or manufacturers' recommendations have been used where available and applicable.
- The inspection, findings, and recommendations are based on our engineering judgment and familiarity with the design, construction, and maintenance requirements of similar structures.
- The inspection findings and recommendations are based on our field data.
- The findings and recommendations are for the use of MTI only.
- The findings and recommendations are WorleyParsons' assessment of the condition of the structure at the specific time of the inspection.
- The inspection is based on examining and reporting only on the condition of the structure. It is not intended as a check of the original design.
- As the inspection is based on visual observations and representative sampling, there is a possibility that hidden or latent defects have not been detected during the course of the inspection. Users of the facility should always report any unusual conditions so that they can be evaluated.
- The inspection carried out on the equipment does not replace regular scheduled maintenance inspections. It is therefore essential that operating and maintenance personnel continuously monitor the equipment appearance and operation, and report any unusual conditions so that they can be evaluated. Maintenance personnel should be trained to observe critical components during the routine maintenance activities.

Subject to the qualifications above, WorleyParsons is of the opinion that the structure is safe to use as intended within normal operational parameters, except for any specific limitation(s) noted in the inspection findings and recommendations.

In the Summary and Recommendations in Section 3, a course of action is recommended for each priority item. All actions indicated must be in accordance with the applicable construction drawings, record drawings, or manufacturers' recommendations and, where indicated in the Summary and Recommendations, the work shall be monitored by a Professional Engineer (P.Eng.).

2. GEOMETRY AND DESCRIPTION

2.1 Reference System

The MTI Canal Bridge No. 6880 is located between North Pender Island and South Pender Island. The reference system of the pier and pile numbering of the inspected portion of the bridge is presented in Figure A. Photos 1 to 3 in Appendix 1 present general views of the bridge.

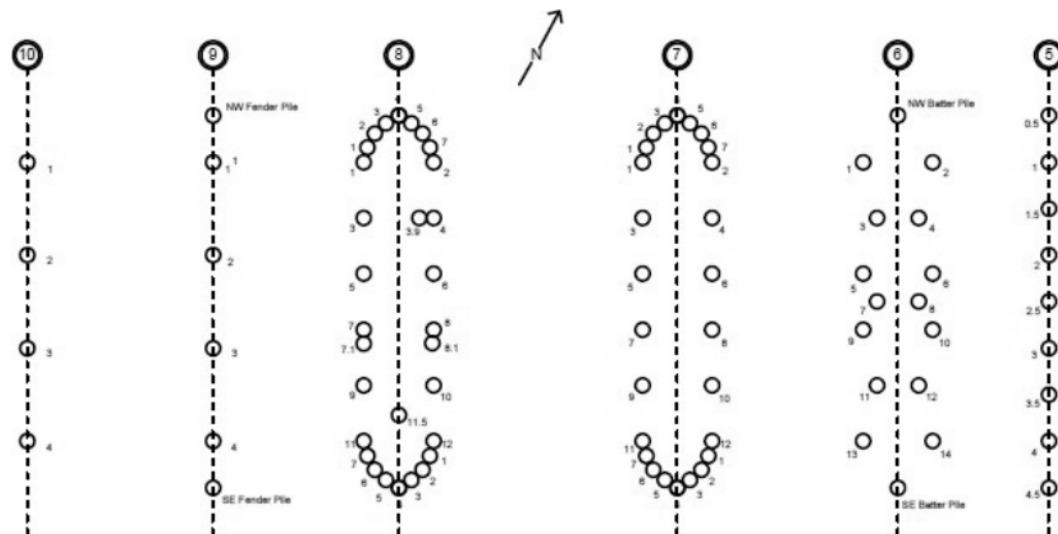


Figure A Pier and Pile Numbering System for the Pender Island Canal Bridge

2.2 Piers

The bridge is supported on 16 piers that are numbered in ascending order from South Pender Island to North Pender Island. The bases of Pier Nos. 5 to 10 are located in the channel between the two islands and contain cross-bracing above and below the water. Pier Nos. 7 and 8 have 7-pile fender groups at the northwest and southeast side of the pier (Photo 4 in Appendix 1). Pier No. 9 has a single fender pile on both the northwest and southeast ends on the pier.

Member geometry is described below:

- Piles: 260 mm to 340 mm in diameter
- Cross-Bracing: 250 mm by 75 mm
- Pile Caps: 300 mm by 300 mm
- Horizontal Sheeting: 200 mm by 75 mm



3. INSPECTION RESULTS

The detailed inspection observations and related reference material are presented in the appendices as described below:

- Appendix A presents the photographs taken during the inspection program.

The general condition of the various elements of the bridge are described below. Tables itemizing members with damage or deterioration, and the recommended repair options, are referenced in and follow the general descriptions.

In reviewing the following, please note:

- The term "serviceable condition" is used to describe an element which still functions in the manner in which it was originally intended.
- The term "monitor for further deterioration" is used to describe an element with damage and/or deterioration but does not require immediate remedial action. It is anticipated that repairs will be required in the future.
- Elevations are recorded to local tide and chart datum according to Canadian Hydrographic Survey.

Abbreviations used in the summary tables are as follows:

- CSL: Cross-Section Loss

Water conditions at the time of the inspection are as follows:

- Visibility: 3 m to 4 m
- Current: 0 m/s to 1 m/s

3.1 Pile Caps

The lower pile caps at the waterline on Pier No. 6 are generally in a serviceable condition with the exception of the southeast end of the southwest sub-cap which has 90% cross-section loss due to fungal decay (Photo 5). The northeast sub-cap and four upper caps have minor fungal decay (Photo 6).

Replacement of the southwest sub-cap between Pile Nos. 9 and 13 along with continued monitoring is recommended.

3.2 Piles

The piles are in a serviceable condition with localized deterioration due to marine borer attack. Specific areas of damage / deterioration at the locations of the Level II inspections are presented in Table A.

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
PENDER ISLAND CANAL BRIDGE NO. 6880 INSPECTION

Table A Damage to Piles

Pier No.	Pile	Description of Damage	Recommendation
6	3	Level II inspection of the pile at the mudline. No damage was observed.	---
	4	75% CSL due to marine borer attack at -1.3 m (Photo 7). The pile diameter in this location is 260 mm.	Replace pile.
	6	0.6 m long by 100 mm wide by 12 mm deep check at the mudline. The pile diameter in this location is 260 mm.	Monitor for further deterioration.
	9	75% CSL due to marine borer attack at -1.0 m (Photo 8). The pile diameter in this location is 260 mm.	Replace pile.
	13	95% CSL at the top of the pile (Photo 9). The pile diameter in this location is 300 mm.	Replace pile.
	14	90% CSL due to marine borer attack at +1.4 m. The pile diameter in this location is 260 mm.	Replace pile.
7	4	Level II inspection of the pile at -2.3 m. No damage was observed.	---
8	4	75% CSL due to marine borer attack at +0.6 m (Photo 10). The pile diameter in this location is 300 mm.	Replace pile.
	5	Level II inspection of the pile at -2.0 m. No damage was observed.	---
	7	75% CSL due to marine borer attack at -1.2 m. The pile diameter in this location is 300 mm.	Replace pile.
	7.1	There is a concrete collar on the lower 0.6 m on the pile. The collar is approximately 100 mm larger in diameter than the pile. There is a 100 mm by 200 mm spall at the base on the collar (Photo 11). Pile is partially bearing; the gap between the pile and the seabed is 50 mm high and extends 175 mm under the pile (Photo 12). The pile diameter in this location is 300 mm.	Repair concrete collar.
	8	There is a concrete collar on the lower 0.6 m on the pile. The collar is approximately 100 mm larger in diameter than the pile (Photo 13). The pile diameter in this location is 300 mm.	---
	8.1	The pile is not bearing on the seabed. The gap between the bottom of the pile and the seabed varies from 125 mm to 400 mm (Photo 14). The pile diameter in this location is 300 mm.	Install a concrete collar at the base of the pile.
	9	90% CSL due to marine borer attack at -1.3 m. The pile diameter in this location is 300 mm.	Replace pile.



Pier No.	Pile	Description of Damage	Recommendation
8	10	The pile is not bearing on the seabed. The gap between the bottom of the pile and the seabed varies from 50 mm to 125 mm (Photo 15). The pile diameter in this location is 300 mm.	Install a concrete collar at the base of the pile.
		Level II inspection of the pile at -0.8 m. No damage was observed.	---
	Southeast Fender No. 3	90% CSL due to marine borer attack at the mudline. The pile diameter in this location is 260 mm.	Replace pile.
9	1	Level II inspection of the pile at -0.6 m. No damage was observed.	---
10	3	There is a concrete collar on the bottom 0.5 m of the pile. The collar is approximately 100 mm larger in diameter than the pile. Half of the collar is undermined by 25 mm but the pile itself appears to penetrate the seabed. The pile diameter in this location is 260 mm.	Monitor for further deterioration.

3.3 Bracing

The cross-bracing is in a serviceable condition with localized deterioration due to marine borer attack. The cross-bracing is referenced from the upper bolted connection to the lower bolted connection. Specific inspection observations are presented in Table B.

Table B Damage to Approach Bracing

Pier No.	Bolted Connections	Description of Damage	Recommendation
6	10 to 8	75% CSL due to marine borer attack at the bolted connection on Pile No. 10 (Photo 16).	Replace cross-brace.
	1 to 9	50% CSL due to marine borer attack at the bolted connection on Pile No. 9.	Replace cross-brace.
	2 to 10	25% CSL due to marine borer attack at the bolted connection on Pile No. 10.	Replace cross-brace.
		75% CSL due to marine borer attack at the bolted connection on Pile No. 2 (Photo 17).	Replace cross-brace.
7	5 to 11	75% CSL due to marine borer attack at the bolted connection on Pile No. 11. There is a replacement brace adjacent.	---
	1 to 7	75% CSL due to marine borer attack at the bolted connection on Pile No. 7. There is a replacement brace adjacent.	---

Pier No.	Bolted Connections	Description of Damage	Recommendation
7	8 to 2	25% CSL due to marine borer attack at the bolted connection on Pile No. 2.	Replace cross-brace.
8	8 to 3.5	50% CSL due to marine borer attack at the bolted connection on Pile No. 3.9.	Replace cross-brace.
9	1 to 4	10% CSL due to marine borer attack at the bolted connection on Pile No. 4.	Monitor for further deterioration.

3.4 Horizontal Sheeting Timbers

The horizontal sheeting timbers on Pier Nos. 7 and 8 are in a serviceable condition with localized severe fungal decay and marine borer attack (Photos 18 and 19). The bottom horizontal sheeting timber on Pier No. 7 has 90% CSL due to marine borer attack between Pile Nos. 1 and 3. The bottom three horizontal sheeting timbers on Pier No. 8 have 75% cross-section loss due to fungal decay at the bolted connection on Pile No. 12.

Replacement of the bottom horizontal sheeting timber on Pier No. 7 between Pile Nos. 1 and 3 and the bottom three timbers on Pier No. 8 between Pile Nos. 10 and 12 along with continued monitoring is recommended.

3.5 Miscellaneous

There is a group of four horizontal timbers that are oriented in the longitudinal axis of the bridge from between Pile Nos. 1 and 3 to between Pile Nos. 2 and 4. The southeast timber has 75% cross-section loss due to marine borer attack. The horizontal timbers are 300 mm by 300 mm.

Replacement of the southeast horizontal timber along with continued monitoring is recommended.

3.6 Foreshore

While not included in the scope of this inspection, it was noted that there is erosion occurring on the south island side of the canal (Photos 20 and 21). Due to the erosion, the embankment is approximately 2.0 m from Pile No. 4 on Pier No. 4.

Consideration should be given to addressing the erosion.

3.7 Soundings

Sounding were taken on the northwest and southeast ends on Pier Nos. 5 to 10. Elevations are recorded relative to the elevation of the top of the pier cap at Pier No. 6. As specified in the Request for Proposal by the Ministry of Transportation, the elevation of the top of the pier cap at Pier No. 6 is 100 m. Sounding measurements are presented in Table C.



Table C Pier Soundings

Pier No.	Northwest Elevation (m)	Southwest Elevation (m)
5	86.8	87.7
6	85.8	86.0
7	85.3	85.1
8	85.2	85.8
9	86.5	87.5
10	88.7	89.7

4. RESIDUAL LIFE ESTIMATES

As an integral part of the inspection program, the estimated remaining useful life of the various components of the structure is presented below. This is an essential part of the long term planning process and is based on the following:

- Where creosote or salt treated timber has been examined for the presence of decay and is found to be in a serviceable condition, an estimated life in excess of eight to ten years is appropriate.
- Where some evidence of decay has been found, but is very limited in extent, the element can be assumed to have a residual life in the order of three to six years on the southwest coast.
- Where an element has a weakened cross-section due to decay, based on visual observation or hammering, and confirmed by drilling, the residual life should be taken as negligible, and the element should be considered unreliable for structural loads.
- Where individual bracing members are damaged and the system is redundant, the importance of the damaged member should be taken into account in assessing the residual life of the system.
- Residual life should be established for each major class of elements in the system; i.e., deck, guardrail, hand railings, stringers, pile caps, piles and bracing, and for individual elements within these classes where replacement of the deficient members is considered practical.

In evaluating the remaining service life of timber structures, it is also important to note the following:

- The above are approximate estimates, as fungal decay (rot) and marine borer attack will spread quickly once established in the structure and conditions are favourable.
- Marine structures of timber construction are typically designed for a service life of 25 years. However, experience has shown that the life expectancy of treated timber can vary from between 20 to 40 years, and 50-year-old timber structures with an ongoing maintenance and repair program are not uncommon in coastal British Columbia.

Residual life estimates of the substructure elements are described below:

- Pile Caps: 6 to 8 years, except as noted
- Timber Piles: 8 to 10 years, except as noted
- Bracing: 6 to 8 years, except as noted
- Horizontal Sheeting Timbers: 6 to 8 years, except as noted



5. SUMMARY AND COST ESTIMATE

The Pender Island Canal Bridge No. 6880 is generally in a serviceable condition, although a repair and maintenance program is recommended to maintain the facility in a safe and operational condition.

A summary of the recommended repair work is presented in Table D. The estimated cost to implement the repairs has also been included to assist in evaluating the significance of the inspection findings.

Table D Summary of Recommended Repairs and Estimated Costs for the Ferry Terminal

Item	Recommended Action	Cost
1	Replace seven bearing piles.	\$28,000
2	Replace one fender pile.	3,000
3	Install two concrete collars.	3,000
4	Repair one concrete collar.	1,500
5	Replace six cross-braces.	6,000
6	Replace four sections of horizontal sheeting.	3,000
7	Replace one horizontal blocking timber.	1,500
Subtotal		\$46,000
Contingency and Engineering ($\pm 35\%$)		15,000
Total		\$61,000

In reviewing the following estimated repair costs, it is important to note the following:

- The estimate is based on early 2012 cost levels and does not include cost escalation.
- Cost estimates do not include any allowances for regular maintenance, upgrades, or further remedial measures to extend the service life unless indicated.
- The estimates do not include any allowances for environmental permitting or project management.
- The estimate is based on in-house experience with similar projects and on budget price quotations from local contractors and suppliers, and assumes a competitive bidding process from local contractors.
- The estimate is based on replacement of structural elements with similar type and size of materials.
- The estimates do not include any applicable taxes.
- It is recommended that a contingency allowance should be included to cover undefined items. This contingency is not a reflection of the accuracy of the estimate, but covers items of work which will have to be performed, and elements of cost which will be incurred, but which are not explicitly detailed or described.

Appendix 1 Photographs



Photo 1: Canal Bridge No. 6880 - general view of the bridge facing north.



Photo 2: Canal Bridge No. 6880 - general view of Pier Nos. 5, 6, and 7.



Photo 3: Canal Bridge No. 6880 - general view of Pier Nos. 8, 9, and 10.



Photo 4: Canal Bridge No. 6880 - 7-pile fender group on the northwest side on Pier No. 8.



Photo 5: Canal Bridge No. 6880 - severe fungal decay to the southwest sub-cap on Pier No. 6.



Photo 6: Canal Bridge No. 6880 - typical minor fungal decay to the pile caps on Pier No. 6.

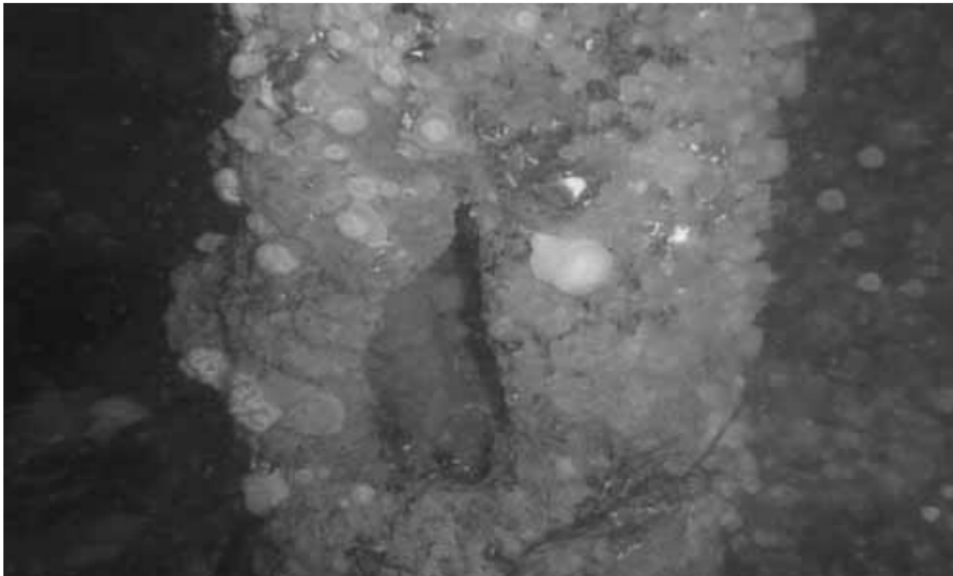


Photo 7: Canal Bridge No. 6880 - marine borer cavity on Pile No. 4 on Pier No. 6.



Photo 8: Canal Bridge No. 6880 - severe deterioration due to marine borer attack on Pile No. 9 on Pier No. 6.



Photo 9: Canal Bridge No. 6880 - severe deterioration due to marine borer attack on Pile No. 13 on Pier No. 6.



Photo 10: Canal Bridge No. 6880 - severe deterioration due to marine borer attack on Pile No. 4 on Pier No. 8.

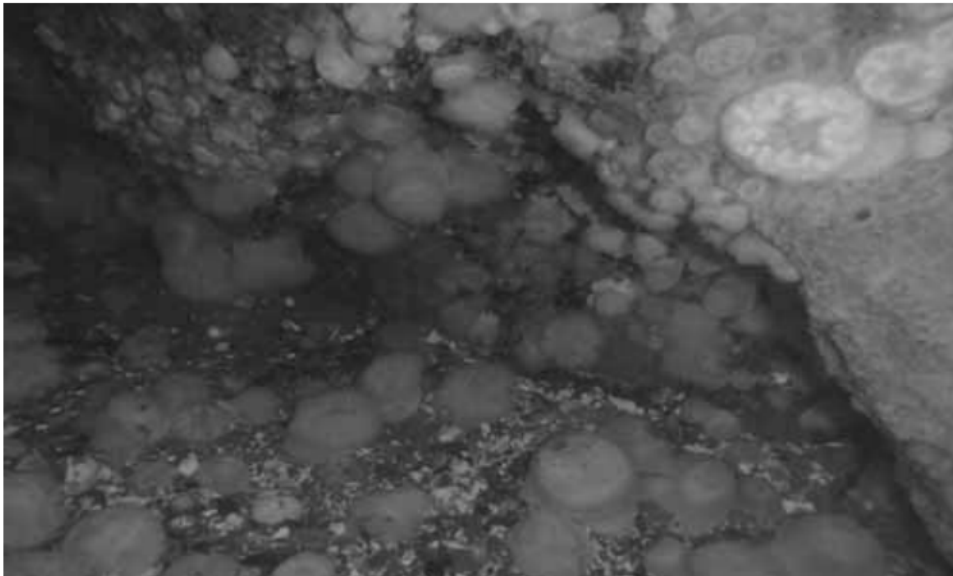


Photo 11: Canal Bridge No. 6880 - spall in the concrete collar on Pile No. 7.1 on Pier No. 8.

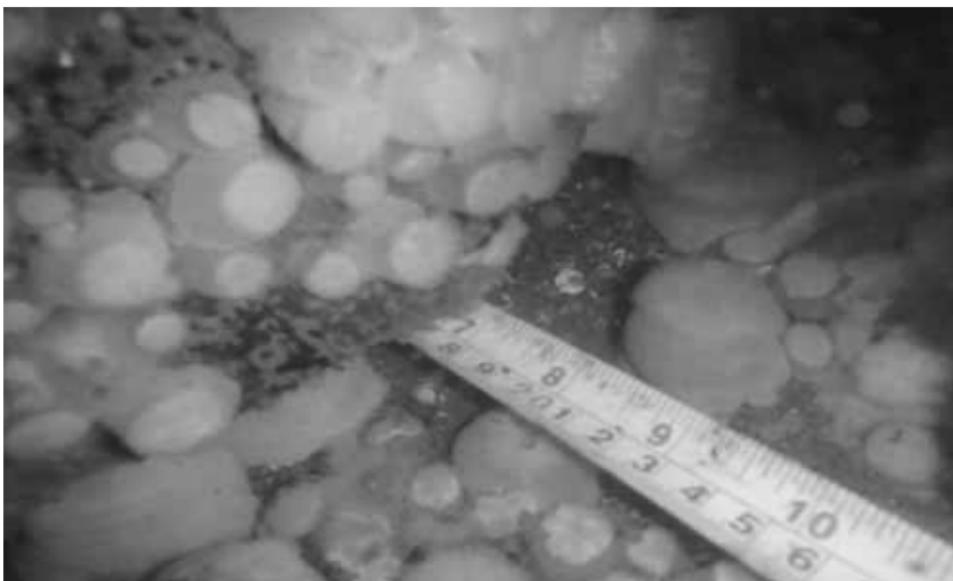


Photo 12: Canal Bridge No. 6880 - Pile No. 7.1 on Pier No. 8 in partial bearing.

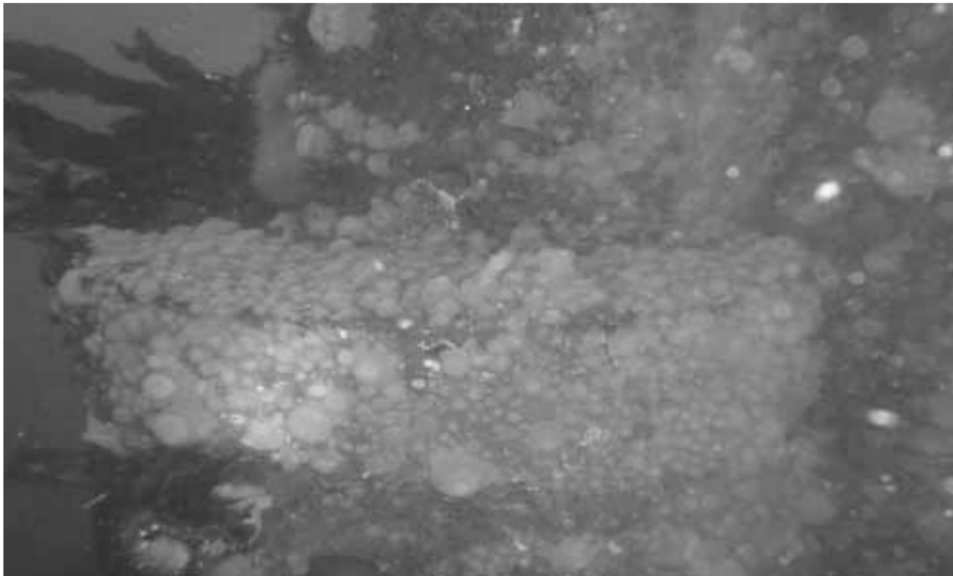


Photo 13: Canal Bridge No. 6880 - concrete collar on Pile No. 8 on Pier No. 8.

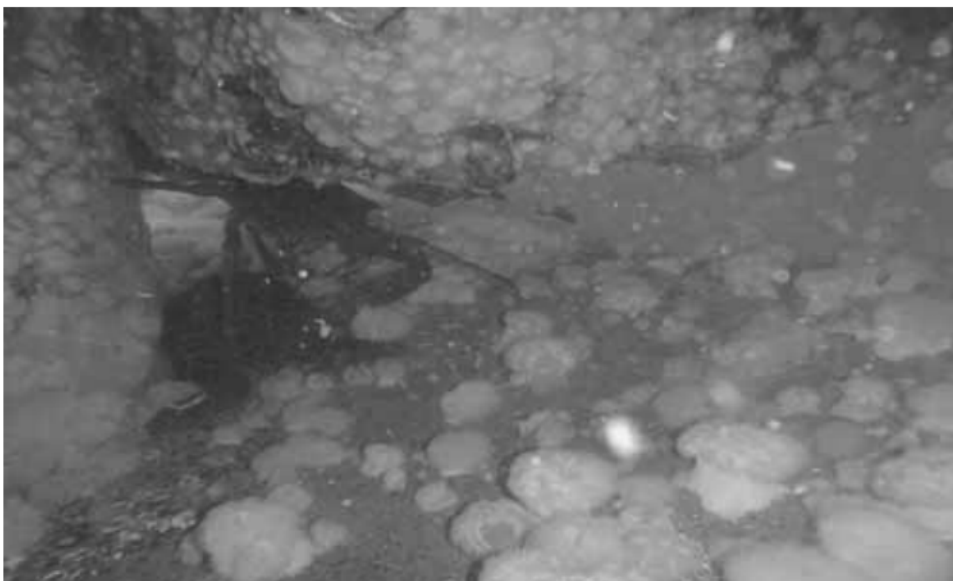


Photo 14: Canal Bridge No. 6880 - Pile No. 8.1 on Pier No. 8 is not in bearing.

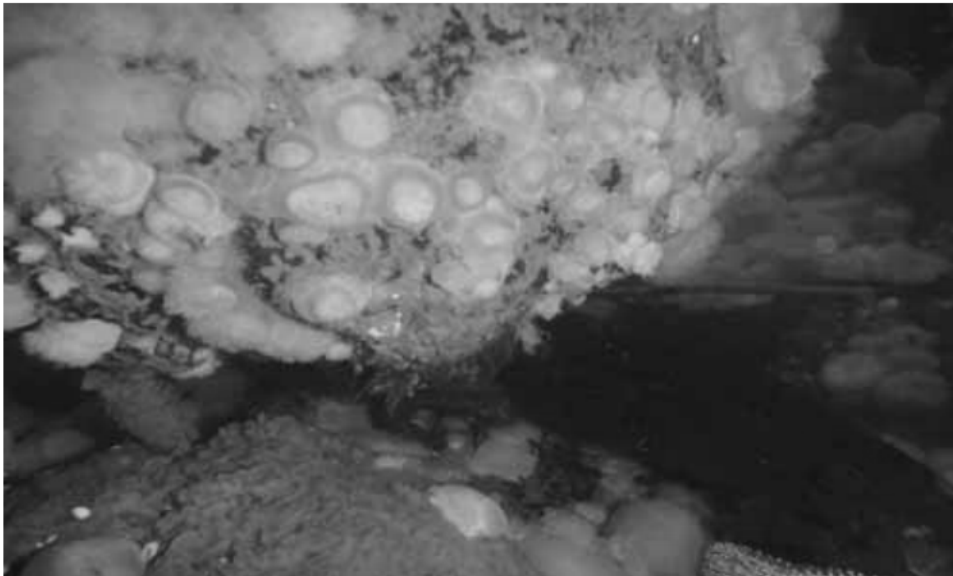


Photo 15: Canal Bridge No. 6880 - Pile No. 10 on Pier No. 8 is not in bearing.



Photo 16: Canal Bridge No. 6880 - severe deterioration due to marine borer attack to a cross-brace on Pier No. 6.

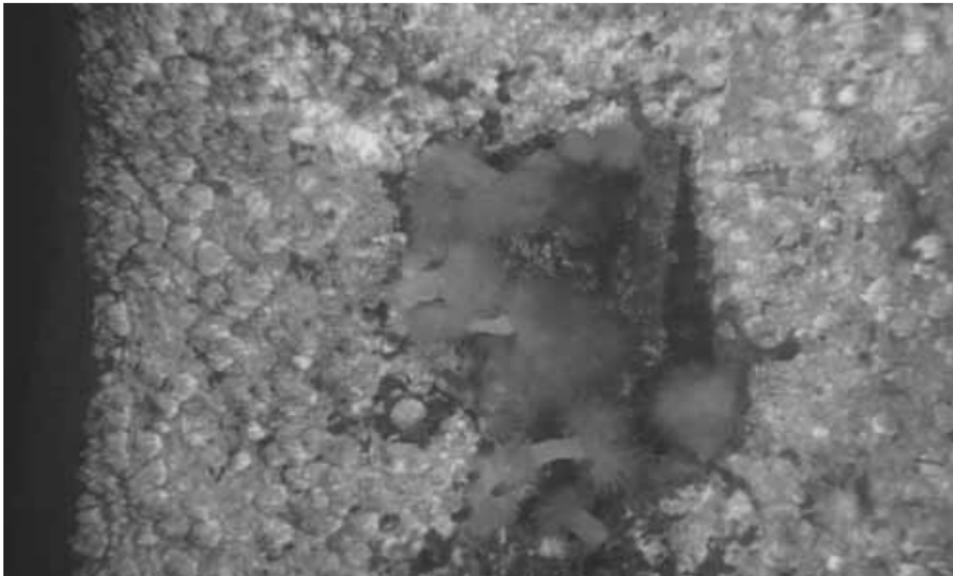


Photo 17: Canal Bridge No. 6880 - severe deterioration due to marine borer attack to a cross-brace on Pier No. 6.



Photo 18: Canal Bridge No. 6880 - horizontal sheeting timbers on Pier No. 8.



Photo 19: Canal Bridge No. 6880 - horizontal sheeting timbers on Pier No. 7.



Photo 20: Canal Bridge No. 6880 - erosion of the embankment adjacent to Pier No. 4.



Photo 21: Canal Bridge No. 6880 - erosion of the embankment adjacent to Pier No. 4.