Lasalle Causeway Bascule Bridge

2019 Comprehensive Detailed Inspection Report (Rev. 1)

Prepared for:

Public Services and Procurement Canada | Services publics et Approvisionnement Canada

PSPC Project Number: R.090045.001

Prepared by:

PARSONS

May 2021

Parsons Project No. 477214-01000

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

The LaSalle Causeway (the Causeway), opened since 1917, provides an important transportation link within the City of Kingston. It carries Highway 2 and approximately 28,000 vehicles a day across the Cataraqui River. The Causeway accommodates a single shared bicycle/vehicle lane of traffic in each direction and consists of five (5) interconnecting structures: the West Bridge, the West Wharf, the Bascule Bridge, the East Wharf, and the East Bridge. The East Bridge and Bascule Bridge provide marine access to the inner harbour of Kingston and access to the southern entrance of the Rideau Canal. The Bascule Bridge accommodates larger marine vessels and lifts an average of 900 times per year.

The Bascule Bridge is a single leaf Strauss heel trunnion bascule bridge, designed by The Strauss Bascule Bridge Co. of Chicago. Construction of the bridge was completed in 1917. The structure is supported on two concrete abutments (also known as piers) founded on timber piles. The main leaf (or through) truss span of the bridge consists of a Modified Warren through truss with a span length of 48.77 m and has an open steel deck grating supported by a floor system comprising of transverse sills, longitudinal stringers, and transverse floor beams located at each panel point. A 1.2 m wide timber plank sidewalk is cantilevered from the exterior of the south truss. The fixed tower truss supports the counterweight truss and the machinery room containing the span drive machinery which is located over the roadway. The counterweight truss above supports the concrete counterweight, which weighs approximately 550 tonnes (1,220,000 lbs.). The structural steel truss members consist of built-up sections of plates, channels, angles, and lattice. The bridge has undergone numerous rehabilitations since its construction in 1917.

Parsons Inc. (Parsons) was retained by Public Services and Procurement Canada (PSPC) in July 2019 to complete the 2019 Comprehensive Detailed Inspection (CDI) of the structural, mechanical and electrical components of the Bascule Bridge. The inspection of the structure consisted of a close-up, detailed visual examination of all exposed surfaces of the above-water and above-grade components, including a detailed deck grating inspection and fatigue inspection with magnetic particle testing. The 2019 CDI also consisted of surveying of the east approach slab and abutment, a Level 1 Underwater Inspection, a limited condition survey of the mechanical room concrete slab, and removal of debris from inside the metal panels enclosing the concrete counterweight. No structural nor seismic evaluations were carried out as part of this assignment.

The key findings of the inspections and recommendations are as follows:

Structural

The recent CDI and fatigue inspections revealed cracks in several leaf truss top chord, bottom chord, and vertical members, in gusset plates at connections (including below the main trunnions), and both cracks and lamination defects in top chord members 1S-3S and 3S-5S. Cracks were also found in counterweight truss member 21N-27N, tower truss horizontals, and at the top and/or bottom cope in 28 of the 72 stringers, including in six adjacent stringers in bay FB14-FB16. The 2019 fatigue inspection discovered that several cracks had increased in length since the 2018 inspection, including in top chord member 3S-5S, tower truss horizontal member 18S-19S, and in 11 of the 28 stringers.

The north and south main trunnion connections exhibit severe localized pitting in the gusset plates, very severe section loss of several rivet heads, perforations in the triangular plates behind FB16, and cracks propagating from perforations at the bottom of the vertical gusset plates between the end of the bottom chord members 14-16 and FB16. Other typical structural steel deterioration noted includes vertical gusset plates at truss nodes with significant section loss in failure planes, perforated structural steel members, gusset plates and batten plates, and rivet heads with severe section loss. Some leaf truss sway bracing members have been damaged by vehicle impact. Welds were noted on several leaf truss members which are typically discouraged on historical steel structures.

Bent and broken bearing and cross bars were observed throughout the steel deck grating, and cracked bar-to-bar and bar-to-sill welds were noted at several locations. The serrated edge has been completely worn away within the wheel tracks in each vehicular lane meaning the grating no longer provides the same slip resistance as designed which could increase vehicle braking distances in poor weather conditions. In February 2017 a section of grating failed and broke off. The replaced section has missing and cracked welds. Two groups of cracked longitudinal bars were noted during the current inspection at the west end of the deck which required the installation of steel plates.

Numerous localized defects are evident in the structural steel coating system. The majority of the defects are on the tower truss members at roadway level, the leaf truss floor system and bracing members, and the leaf truss members and connections at and below deck level. Defects include cracks, flaking, and complete loss of the coating. At locations of coating loss, active corrosion has developed.

The visible concrete on the exterior surfaces of the counterweight is mostly in poor condition and exhibits isolated cracks, map cracking, delaminations, scaling and spalling, extensive disintegration, efflorescence deposits and wet stains. Damp staining, large areas of light corrosion, perforations, and impact damage were noted on the metal panels. Disintegrated concrete and some organic matter that had collected between the concrete and the soffit sheet metal cladding was removed during the inspection.

The thrie-beam traffic railings on the bridge do not meet current Canadian Highway Bridge Design Code CAN/CSA S6-14 (CHBDC) crash-tested requirements for bridge barriers, and the beams are mounted directly to the road side of the leaf truss members, therefore there is a possibility that vehicle collision along the barrier could subject primary members of the main truss to damage or failure. PSPC should consider accepting the liability of the railings not meeting CHBDC crash-tested requirements following a detailed review of the performance of the railing system based on accident history.

The approach guide rails do not meet current MTO standards and TAC requirements and may not be able to re-direct errant vehicles back onto the roadway which could subject primary members of the tower truss or though truss to damage or failure. The breakaway type timber posts in the southwest guide rail may permit the guide rail to deflect onto the sidewalk in the event of vehicle impact, which is a potential hazard to pedestrians.

The soffit of the mechanical platform concrete slab has widespread deterioration including delaminated areas over traffic lanes which should be scaled as a matter of urgency to prevent them from falling onto traffic below. Other defects include widespread scaling, several localized areas of light honeycombing, medium cracks, and spalling. Some of the spalls have exposed corroded rebar. The topside of the slab (in the mechanical room) has light scaling.

There are currently no safety chains nor gates at openings in railings or fall-arrest cables at ladders, which are potential safety hazards. A complete Health and Safety review/audit of the stairs and catwalks should be carried out to identify all locations of potential falling hazards.

The current Structural Condition Rating is 3 (Poor). The recent fatigue inspections revealed cracks in several leaf truss members and connections, a counterweight truss member, tower truss horizontals, and in 27 stringers, and lamination defects in a leaf truss top chord member. Repairs are required to the main trunnion connections, concrete counterweight, numerous other primary truss members and connections, the structural steel coating system, and the steel deck grating. Multiple secondary components also require repairs. The 2017 Structural Evaluation Report by Parsons indicated that the structure meets the current CHBDC load cases for live loading requirements in the closed position, although it should be noted that the evaluation has not been updated to account for the additional deterioration observed during the current inspection. It is not known if the structure satisfies the seismic requirements of the current CHBDC. The results of the 2020 Main Trunnion Rehabilitation Study – Structural Evaluation Report indicate that when the bridge is operated, i.e. in the open position, the structure does not satisfy CHBDC special load case requirements for moveable bridges and the members and connections at and around the main trunnion need strengthening, even if a reduced operating wind speed of 60 km/h is imposed. The forces in the main trunnion assemblies when the bridge is in the open position are mainly influenced by the wind and not by the operating impact.

In the bridge's current configuration, the Functional Rating is 2 (Inadequate). The clear distance of 7.3m between the timber curbs on the deck does not meet the minimum width requirements of the Geometric Design Guide for Canadian Roads (GDGCR) by the Transportation Association of Canada (TAC), the structure's vertical clearance of 4.2 m is more than 10% below the requirements of the GDGCR, and the minimum width of the sidewalk of 1.2m is below the practical lower limit of 1.5m. The thrie-beam traffic barriers on the bridge do not meet current CHBDC crash-tested requirements, and a vehicle collision could subject primary members of the main truss to damage or failure. The guide rails do not meet current MTO standards or TAC requirements.

Given the structural and functional issues listed above, it is recommended that PSPC considers planning for the replacement of the bridge in the near future. In the meantime, numerous repairs are recommended to keep the bridge operational. The major structural, mechanical, and electrical components recommended for rehabilitation and ongoing maintenance items are as follows. All costs indicated include relevant Cost Amplification Factors as provided by PSPC, and an assumed annual inflation rate of 2%.

Priority U repairs are recommended to scale the any additional delaminated areas on the underside of the mechanical housing slab ($7k) until permanent repairs are performed; and reinstall the Low Clearance sign on the east portal frame ($5k).

The following Priority S work is recommended: carry out a complete Health and Safety review/audit of the stairs and catwalks to identify all locations of potential falling hazards ($24k); monitor the deformation of the floor beams during future inspections ($4k); measure and monitor the deformation of 12N-13N and 14S-16S during future inspections ($4k and $4k); perform targeted fatigue inspections with NDT support of all structural steel members every two years ($101k).

Repairs to the following elements will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (Priority A, $1.86M): approach slabs; north live load support; structural steel coating system; deck grating; stringers; sills; joint armouring; structural steel (Leaf Truss Top Chords 1S-3S, 3S-5S, 13N-16N; Leaf Truss Bottom Chords 0N-2N, 0S-2S, 14S-15S, 14S-16S; Leaf Truss Vertical 1N-2N; Leaf Truss Diagonals 8S-9S, 9S-10S; Tower Truss Members 14N-17N, 15S-17S, 18S-19S, 15S-18S; Main Trunnion Connections 15N/16N, 15S/16S; Counterweight Truss Members 21N-27N, 26N-26S, 21S-27N.)

Additional Priority A repairs are recommended to modify the approach guide rails to meet current MTO standards ($39k); south roadway railing post anchorage modifications, installation of a chain above the south trunnion, and replacement of missing thrie-beam bolts ($8k).

It is understanding that PSPC intends to combine the rehabilitation of the Main Trunnion connections (and connecting truss members) and the concrete counterweight into a single design and construction package, with construction anticipated in late 2021 to early 2022 ($6.24M).

The traffic staging required to complete the replacement of the deck grating, sills, and (possibly) the stringers will undoubtedly cause major delays to vehicular traffic, and therefore to minimize disruption as much as possible it may make sense to wait until the Third Crossing is open (currently scheduled for late 2022). To further reduce disruption to bridge users it is recommended that the remaining recommended repairs are combined into a single major rehabilitation in 2023 (Priority B), which would include: mechanical housing soffit concrete repairs; marine structure repairs; repairs to catwalks and stairs; replacing the corroded south live load support bolt; curb and sidewalk repairs; structural steel coating repairs; replacement of the steel deck grating, sills, and stringers; Tower Truss and Leaf Truss structural steel repairs; concrete substructure repairs ($5.18M).

Mechanical

The general condition of the Bascule Bridge mechanical machinery systems is fair. Many of the primary components are well-maintained and in suitable condition for long term service based on this inspection. However, there are components with unusual wear that should be investigated, a number of tasks that require maintenance activity, and some conditions that require a significant effort to address.

The motors, motor brakes, and span drive control unit were replaced as part of a rehabilitation project in 2018. The machinery operated reliably during the inspection.

A significant concern for public safety is that there is not a traffic barrier system installed on the east approach. The warning gates provided are not adequate to prevent a vehicle from leaving the roadway. Note that the CHBDC does not require a traffic barrier but simply states that consideration should be given to providing one. A traffic barrier has been considered by PSPC and it has been deemed unnecessary at this time.

Disassembly and inspection of the south pinion guide assembly was performed in November 2015. The conditions at the south assembly were found to be similar to the previously-inspected north assembly, with poor pinion, shaft, and key fits. Repairs to the north assembly were completed in 2018. A failure at the south pinion and shaft connection would result in a catastrophic loss of control of the structure which may damage the bridge and/or marine vessels as well as cause a lengthy marine outage. Repairs are recommended. If the repairs are not pursued, the south assembly should be monitored to the extent possible by maintenance personnel. It is recommended that an in-depth inspection of the south pinion guide assembly, similar to that performed in 2015, be performed every 5 years.

The condition of the structure near the main trunnion bearings is a concern. There is contact between the moving structure and the fixed structure in the vicinity of the main trunnion bearings during operation of the bridge. The contact is at the outboard side at both bearings and may be a result of contraction of the bridge due to temperature. Contact at these locations should be monitored over varying temperatures. In addition to this contact, four mounting bolts at each main trunnion bearing have failed due to corrosion and should be replaced.

The full open operating strut support rollers are not currently used or maintained. Due to the current full opening angle of about 65°, the full open operating strut support rollers are not needed. If the bridge is ever to be opened to the design opening angle of 84°, rehabilitation of the full open operating strut support rollers will be needed.

There are several machinery components that have significant wear or excessive clearance including the south inboard operating strut bearing and the lower east operating strut guide roller bushing (this was documented in the SBE 2015 secondary inspection; note that it is not verifiable without disassembly of the strut guide assembly). The re-bushing of the south operating strut guide roller should occur in conjunction with rehabilitation of the south pinion guide assembly.

The span locks are generally in fair condition with minor exceptions. The span locks operated properly at the time of the inspection, however two of the south receiver mounting screws are not engaged with the support and the receiver is tilted towards the approach. Additionally, a majority of the span lock components were not fully painted and corroded. The components that were corroded include the position indication adjustable arms, the motor and reducer mounting bolts, the B3 bearing mounting bolts, the shaft between B3 and B4 bearings, and the front and rear guide mounting bolts. The span lock machinery was rehabilitated in early 2017 and the condition of this machinery indicates that maintenance practices should be adjusted to ensure longevity of the machinery.

The live load supports and buffers are generally in fair condition with minor exceptions. The bridge does not seat firmly on both live load supports and bounces under live load from traffic. The underside of the live load strike plate assemblies and the top side of the supports are not fully painted and are corroded, this condition has worsened since the 2018 inspection. The new motors and drive installed in 2018 has made the function of the buffers superfluous. The buffers remain installed on the span and the span drive machinery must drive through their resistance to seat the span. Driving through the resistance of the buffers results in excessive seating torque on the bridge drive system which in turn reduces the design life of the motors, drives and associated machinery.

The warning gates are in fair condition and operated reliably. The gate arms are not horizontal and vertical in the lowered and raised positions and require adjustment. In addition, the gate arms and gate housings are corroded.

Poor bearing alignment and minor damage to some of the span drive gears have all been noted dating back to the 2011 CDI. There does not appear to be any significant degradation in the bearings or gear wear since that time.

In addition to the above issues, there are a number of other maintenance tasks that are recommended to address paint deterioration, unpainted fasteners, and similar smaller issues that could affect the machinery installations if neglected in the long term.

Electrical

The condition of most of the electrical bridge components has not changed since the last inspection performed in 2018. This includes the new main drive motors and drive controllers that were installed during 2018 which provides the bridge with desirable variable speed and torque control for the moving span. The bridge control system was also modified as part of this latest rehabilitation project to remove the manual control of span motion and introduced safety logic to avoid possible human error. Additional interlocks for the traffic control equipment were also added to the existing control system in accordance with CHBDC requirements.

The new drive system utilizes two squirrel-cage induction motors configured as redundant units, the two motors can also be configured to operate together as duty motors if additional torque is required for bridge operation. A motor selector switch is provided on the control desk allowing the operator to switch between the two drive motors or to use both motors to operate the bridge. Note that when both motors are selected, one of the two VFD drives must be switched to follower mode. The modified control system in conjunction with the manual lever switch provides the bridge with safe and automatic control of bridge operation.

The location of the seated limit switches at the toe end is not appropriate, has been problematic, and can be affected by the water and wave action during times of high tide and storm conditions. The seated limit switches were found to have water egress inside their limit switches which have and, in the past, and may in the future, cause failures.

The majority of the required repairs identified are scheduled to be performed in an electrical repairs contract in 2021. The major repair items will include:

- Replacing the existing bridge relay control logic with a modern redundant PLC based system.
- Replacing the operator's control desk with a modern desk containing an HMI and logically laid out bridge control devices.

- Adding an additional red/green pivoting navigation light at the toe end of the moving structure.
- Cleaning all traffic gate limit switches and provide protective covers over them.
- Providing a load bank for the existing standby generator to enable it to be exercised under load without operating the bridge.
- Providing door limit switches and hand crank limit switches on all traffic gates.
- Relocating the seated limit switches to a different location to avoid further water damage.

The following table describes the anticipated life expectancy of the existing electrical systems installed at the bridge. It assumes appropriate and regular maintenance will be carried out and no unforeseen incidents or damage occurs to the installation.

COMPONENT	LIFE EXPECTANCY BASED ON PRESENT STATUS OF TECHNOLOGY	REPLACEMENT NOTES
Main Electrical Service	25 to 30 years	Replace existing pad mounted transformer
Generator	25 years	Assuming continued regular maintenance
Main Span Drive Motors and Drives	30 years	Replace with State-of-Art drive technology
MCCs	One rehab. or replacement	One rehab. or replacement
Bridge Control System, PLC, and UPS	Two rehabs. or replacements	Two rehabs. or replacements
Span Drive Brakes	Covered by mechanical replacement of span drive machinery	None
Span Lock Actuators	15 to 20 years	Replace with devices exposed to the harsh environment
Main Control Desk	20 years	Replacement due to obsolescence and no longer supported
Bridge Control System	20 years	Replacement due to obsolescence and no longer supported
Operational Devices	On an as needed basis	Replacement part of ongoing maintenance
Traffic Control - Gates	15 to 20 years	Replace with devices exposed to the harsh environment
Traffic Control - Lights	15 to 20 years	Replace with devices exposed to the harsh environment
Traffic Control – Horn	25 years	Replace with devices exposed to the harsh environment
Conduit, Junction Boxes, & Cable Trays	30 years	Will be minor replacements covered by maintenance on an ongoing basis
Submarine Cables	30 years	May require protracted environmental permitting
Lighting	30 years	May require replacement of devices earlier based on energy conservation
Fire Alarm System	20 years	May require upgrade and communications
CCTV	15 years	Replace with State-of-Art drive technology

1. Introduction

The LaSalle Causeway (the Causeway) carries Highway 2 across the Cataraqui River within the City of Kingston, providing an important transportation link between the downtown area on the west side of the river with the Barriefield/CFB Kingston area on the east side of the river. The Causeway was constructed in 1916 and is now owned and operated by Public Services and Procurement Canada (PSPC). Approximately 28,000 vehicles cross the Causeway daily. The Causeway consists of five (5) interconnecting structures: the West Bridge, including its west approach (constructed in 1994); the West Wharf (1916); the Bascule Bridge (1917); the East Wharf (1916); and the East Bridge, including its east approach (1968). The Bascule Bridge and the East Bridge both provide marine access to the inner harbour of Kingston and access to the southern entrance of the Rideau Canal, with the Bascule Bridge lifting an average of 900 times per year for larger vessels. The Causeway accommodates one shared bicycle/vehicle lane of eastbound traffic and one shared bicycle/vehicle lane of westbound traffic. The 2015 Kingston Transportation Master Plan indicates that Highway 2 at the Crossing is classified as an arterial road. The location of the Causeway is shown on the key plan (Figure 1).

In July 2019 Parsons Inc. (Parsons) was retained by PSPC to complete the following:

- The 2019 Comprehensive Detailed Inspection (CDI) of the Bascule Bridge (including structural, mechanical and electrical inspections);
- The 2019 CDI of the East Bridge and West Bridge;
- The General Annual Inspection (GAI) of the West Wharf and East Wharf;
- The removal of loose debris from the Bascule Bridge's concrete counterweight (provisional);
- A detailed inspection of the Bascule Bridge steel deck grating;
- An inspection of all underwater components of the Bascule Bridge, East Bridge, West Bridge, East Wharf, and West Wharf;
- Ongoing monitoring of movement of the West Bridge abutment bearings;
- A surveying program to determine if ongoing settlement is occurring at the east approach slab and east abutment;
- A fatigue inspection involving non-destructive testing (NDT) at select locations on the Bascule Bridge; and
- A limited condition survey including materials testing of the Machinery Room's concrete slab soffit.

The data obtained from the east approach and abutment survey, and the findings of detailed grating inspection, fatigue inspection, and limited condition survey are included in this report. The detailed findings of the underwater inspection for the Causeway are included in a separate report, although relevant findings of the inspection have been incorporated into this report. The findings of the 2019 CDI of the East Bridge and West Bridge (including the monitoring of the West Bridge abutment bearings) are provided in separate reports (one report for each structure). The inspection of the mechanical and electrical systems and components were undertaken by Parsons' sub-consultant Stafford Bandlow Engineering Inc. (Stafford Bandlow) from Doylestown, Pennsylvania. Note that Stafford Bandlow is now a division of Wiss, Janney, Elstner Associates Inc. (WJE). Parsons and Stafford Bandlow were responsible for carrying out a review of all available information, carrying out the field inspections, and preparation of the inspection report for the Bascule Bridge.

This report documents and summarizes the findings of the visual inspection of all above-water and below-water components, provides a condition rating and functional rating of the structure, recommended repair programs, and a 10-year Management plan with Class 'D' cost estimates. Completed PSPC Field Observation Record Forms (MCR/PCR) forms are included in Appendix A. General Arrangement drawings of the structure are included in Appendix B along with deterioration drawings of the marine structures and main trunnion connections. Selected annotated photographs of the existing condition of deteriorated areas and general photos of the structures are included in Appendix C. Photographs from the mechanical and electrical inspection are included in Appendix D and Appendix E, respectively. The details of the work performed during the removal of the counterweight debris are included in Appendix F. The bridge deck grating deterioration drawings are provided in Appendix G. The data from the survey field work is included in Appendix H. The limited condition survey report for the Machinery Room's concrete slab soffit is included in Appendix I. Baseline measurements of the deformation of bottom chord member 14S-16S are contained in Appendix J.

Since carrying out a detailed evaluation of rehabilitation alternatives and financial life-cycle cost analysis of the alternatives is outside the scope of this report, the rehabilitation recommendations and cost estimates included within have been developed for the structure to address deficiencies noted in the current and previous inspection and evaluation reports only. The recommended repairs detailed in this report are not intended to serve as an operational review of the Bascule Bridge or Causeway, nor a code and standards requirements review.

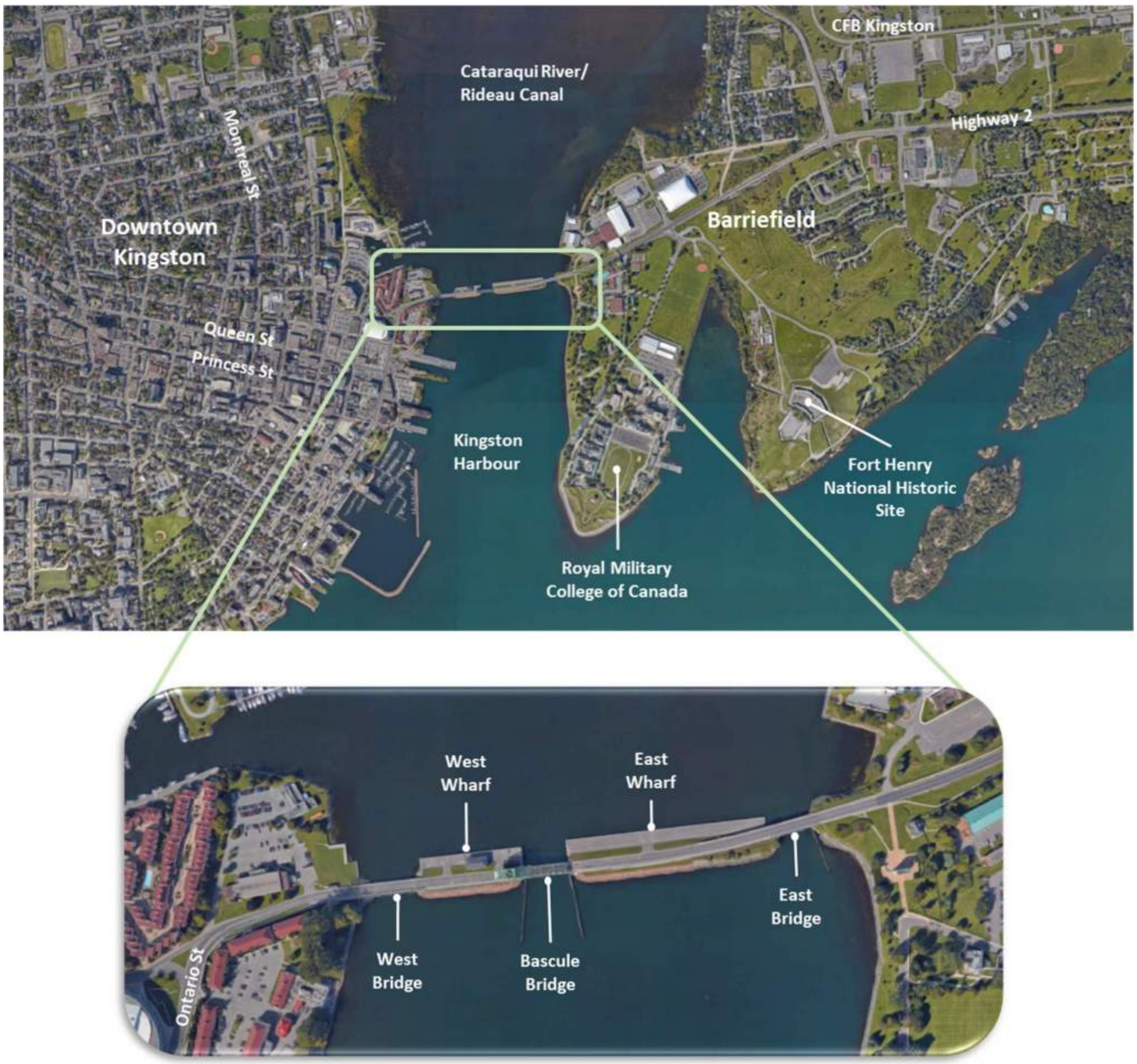


Figure 1: Key Plan (from Google Maps)

2. Structure Description

The Bascule Bridge is a single leaf Strauss heel trunnion bascule bridge, designed by The Strauss Bascule Bridge Co. of Chicago (Photos S1 to S8, Appendix C). Construction of the bridge was completed in April 1917. The structure is supported on two concrete abutments (also known as piers) founded on timber piles (based on available original drawings), the front faces of which are protected with steel sheet piling (Photos S9 and S10).

The main leaf truss span of the bridge spans between the East Wharf and West Wharf and consists of a Modified Warren through truss with a span length of 48.77 m (160’). The centre-to-centre truss width is 8.23 m (27’) and the centre of bottom chord to centre of top chord height varies from the east to the west end from 6.10 m (20’) to 7.92 m (26’). The bridge has a posted vertical clearance of 4.2 m and a vertical clearance above the water of approximately 0.59 m at the time of the inspection.

The roadway width on the bridge is 7.32 m (24’) and carries one eastbound and one westbound shared vehicle/bicycle traffic lane on an open steel deck grating (Photo S7). The deck grating is supported by a floor system comprising transverse sills, nine longitudinal stringers, and transverse floor beams located at each panel point. A 1.2 m (4’) wide timber plank sidewalk is cantilevered from the exterior of the south truss.

The fixed tower truss supports the counterweight truss and machinery room. The lower members of the north and south trusses are located directly adjacent to the roadway. The counterweight truss above supports the concrete counterweight.

The top chords, bottom chords, verticals, diagonals, cantilevered sidewalk floor beams, sway bracing and struts, top lateral bracing, fixed tower, counterweight link, operating strut, and counterweight truss members consist of built-up sections of plates, channels, angles, and/or lattice. Repairs carried out under previous contracts have strengthened or repaired some deteriorated members and replaced lacing with cut out steel plates on others.

The concrete counterweight weighs approximately 550 tonnes (1,220,000 lbs.) and is suspended from the counterweight truss. The counterweight has an internal steel truss structure and is reinforced at the exterior faces by steel bars and wire mesh. There are steel plates mounted on the north and south faces which are secured in place by threaded steel rods. Two pockets are provided in both the east and top faces of the counterweight, which can accommodate additional dead load required to balance the bridge. The current additional dead loading includes concrete blocks and catch basin lids.

The machinery room containing the span drive machinery (brakes, motors, open gearing, etc.) is located over the roadway and supported within the fixed tower truss. Access to the machinery room, top of the counterweight, bearings and pins is provided by various catwalks, stairs, and access ladders. The operator’s control house containing the electrical systems for bridge operations is located to the northwest of the structure on the east end of the West Wharf. The building containing the PSPC office and workshop is located on the West Wharf.

A galvanized steel 3-rail railing system, consisting of HSS sections with woven wire mesh panels, is located on the south edge of the exterior sidewalk. There are galvanized steel railings matching the profile of the railing on the bridge on the southeast and southwest wing walls. Chain link fences have been installed on the southeast and southwest embankments preventing public access to the substructure. Steel beam guiderails are present at the northeast, northwest, and southwest quadrants. There are timber fender walls comprising timber piles, pile clusters, walers, and dolphins at the southeast and southwest quadrants. Roadway lighting on the bridge is provided by four LED light fixtures (two per side) and sidewalk lighting is provided by a single LED light fixture, all with the cobra head brackets fixed to the inside of vertical truss members. The lighting supports have been welded to the truss members which is typically discouraged with historical steel structures. A navigation light is bolted to vertical member 7-8 on each side of the structure.

Figure 2: South elevation

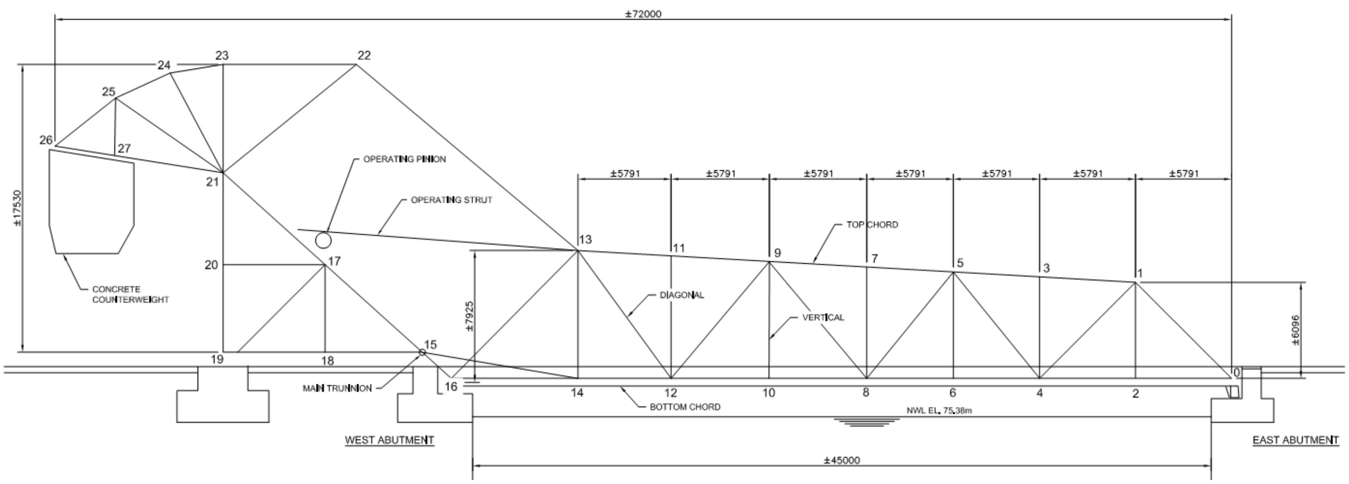


Figure 3: Dimensions and Truss Member Designation

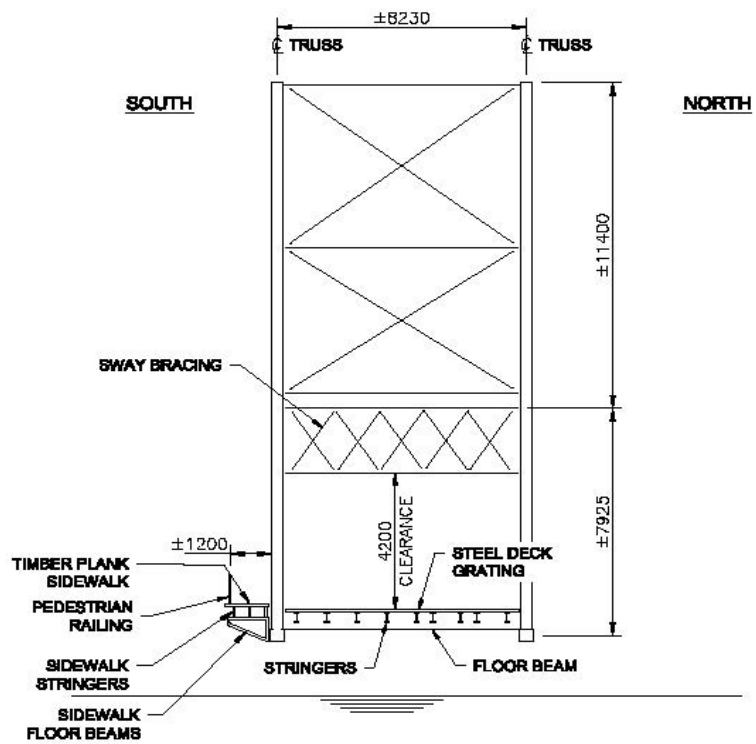


Figure 4: Cross section (looking west).

3. Data Collection and Review

The following reference material provided by PSPC or available in Parsons' own files was reviewed and used in the inspection of the bridge and preparation of this report:

1. "LaSalle Causeway Bascule Bridge – Main Trunnion Rehabilitation Study – Structural Evaluation Report"; Project No. R.099350.002; Parsons Inc.; May 2020.
2. "LaSalle Causeway Bascule Bridge - Steel Deck Grating Replacement Study – Phase 1 Feasibility Assessment (Rev.1)"; Project No. R.09736.004 and R.089507.003; Parsons Inc.; April 2020.
3. "LaSalle Causeway Bascule Bridge – 2018 Comprehensive Detailed Inspection Report"; Project No. R.099350.002; Parsons Inc.; November 2019.
4. "LaSalle Causeway – Mechanical Systems Repair"; Issued for Tender Drawings; Project No. R.100019.001; Parsons Inc.; July 2019.
5. "LaSalle Causeway Bascule Bridge – 2018 Fatigue Inspection and Evaluation Report"; Project No. R.099350.002; Parsons Inc.; March 2019.
6. "2017 LaSalle Causeway – Comprehensive Detailed Inspection Report (Final Rev.1)"; Report; Project No. R.089507.040; Parsons Inc.; March 2018.
7. "LaSalle Causeway – Motor Controls"; Issued for Tender Drawings; Project No. R.089507.020; Parsons Inc.; November 2017.
8. "LaSalle Causeway – Bascule Bridge, Guide Assembly - Key Repair"; Issued for Tender Drawings; Project No. R.089507.070; Parsons Inc.; November 2017.
9. "LaSalle Causeway – Structural Steel Repairs", Issued for Tender Drawings; Project No. R.09507.060; Parsons Inc.; September 2017.
10. "LaSalle Causeway – Bascule Bridge – detailed grating inspection"; Parsons; March 2017.

11. "LaSalle Causeway – Bascule Bridge Structural Evaluation"; Parsons Inc June 2017.
12. "Span Balance Analysis and Buffer Commissioning Report, LaSalle Causeway Bascule Bridge"; Report; Stafford Bandlow Engineering Inc.; May 2016.
13. "LaSalle Causeway Bascule Bridge over the Cataraqui River – 2015 Secondary Mechanical Inspection Report"; Report; Stafford Bandlow Engineering Inc.; January 2016.
14. "LaSalle Causeway – Bascule Bridge, Replacement of Span Locks"; Issued for Tender Drawings; Project No. R.082857.001; Parsons Inc.; November 2016.
15. "LaSalle Causeway Railing"; As-Built Drawings; Project No. R.079547.001; AECOM; June 2016.
16. "LaSalle Causeway 2015 Annual Comprehensive Detailed Inspection Report"; Report; Parsons; September 2015.
17. "LaSalle Causeway Trunnion Joint Inspection and Analysis Report"; Report; MMM Group; June 5, 2015.
18. "LaSalle Causeway Bascule Bridge - Railing Improvements 2012"; Public Works and Government Services Canada, September 2014.
19. "Inspection of existing Buffers and existing Span Locks"; Letter; Parsons., New York; April 30, 2014.
20. "LaSalle Causeway Comprehensive Detailed Inspection"; Genivar, March 2014.
21. "LaSalle Causeway Bascule Bridge – Deck and Sidewalk Concepts Report"; Delcan Corporation, June 2013.
22. "Kingston LaSalle Causeway Bridge – Upgrades of Operational/Safety Systems Phase II"; McCormick Rankin Corporation; January 5, 2012.
23. "2011 Comprehensive Detailed Inspection Report for LaSalle Causeway"; Delcan Corporation; December 2011.
24. "2010 Comprehensive Detailed Inspection Report for LaSalle Causeway"; McCormick Rankin Corporation; March 15, 2011.
25. "2010 Level One Underwater Inspection Report for LaSalle Causeway"; McCormick Rankin Corporation; March 15, 2011.
26. "LaSalle Causeway – Bascule Bridge, Repairs and New Coating"; As-Built Drawings S01 to S25; Project No. R.012359.001; McCormick Rankin Corporation; September 16, 2010.
27. "LaSalle Causeway (Coating)"; Contract Specifications; Project No. R.012359.001; McCormick Rankin Corporation; July 2009.
28. "Kingston Bascule Bridge – Fatigue Review and Rehabilitation of Counterweight Members (Updated After Construction)"; McCormick Rankin Corporation; January 2005.
29. "Seismic Structural Analysis of the LaSalle Causeway Bascule Bridge"; Report No. 4653; McCormick Rankin Corporation; October '01.
30. "LaSalle Causeway, Reconstruction of East Section, North Side, Kingston, Ont."; Design Drawings; Plan No. 3367, Sheets 1 to 3 of 4; Public Works of Canada; Ottawa, Ont.; March 28, 1949.
31. "Kingston City, Reconstruction of Roadway, LaSalle Causeway, Kingston, Ont."; Design Drawing, Plan No. 2614, Sheet 1 of 2; Public Works, Canada; Ottawa, Ont.; June 21, 1934.
32. "Strauss Trunnion Bascule Bridge (Patented) over Cataraqui River, Kingston Harbor Improvements for Dept. of Public Works"; As-Built Drawings (1 to 22); The Strauss Bascule Bridge Co., Chicago; January 21, 1915.

4. Rehabilitation History

The Bascule Bridge has undergone numerous rehabilitations since its construction in 1917, which according to the available drawings, previous inspection reports, and other documentation includes:

1938: Relocation of the operator's control house from the bridge to the West Wharf.
1947: Reconstruction of the office and workshop building.
1958: Replacement of the two drive motors.
1966: Renewal of the operating mechanism and span lock gears; repairs to the east abutment / rest pier; renewal of the live load supports.
Between 1971 and 1976: Replacement of the leaf truss floor beams and stringers, sills, deck grating, cantilever floor beam bracing, some bottom lateral bracing angles, and adjustment of front end shoes. Installation of new traffic signals and bridge lighting.
1977: Repairs to portal frame truss 1S-1N and sway bracing members 5S-5N and 9S-9N.
1985: Reconstruction of the operator's control house.
1991: Repairs to the bottom chord (unspecified location).
1993: Electrical and mechanical upgrades.
1997: Structural steel repairs to 14S-15S, 14N-15N, 14S-16S, 14N-16N, and cantilever floor beam gusset plates, and strengthening of leaf truss vertical members.
2001: Installation of two additional dampers.
2002: Structural steel repairs at node 0S, counterweight truss member 21S-27N, and member 15S-16S; installation of steel beam approach guide rails.
2004: Replacement of rivets in fatigue prone members of the counterweight truss.
2009: Repairs to main trunnion steel plates below roadway level.
2009-2010: Major rehabilitation including the removal of lead paint and application of low VOC protective coating to all structural steel members of the bridge; structural repairs to deteriorating steel members (operating arm, bottom gusset plates, exterior splice plates in the bottom chord); reinforcing certain diagonal truss members; replacing timber sidewalk stringers and deck planks; installation of a new pedestrian railing meeting CHBDC requirements for a combination pedestrian/bicycle barrier; traffic barrier replacement; and replacing wood stairway treads with steel treads.
2011: Addition of steel plates to the west side of the counterweight for balancing purposes.
2012: Roadway and bridge lighting upgrades, and installation of the CCTV system.
2012: Modifications to the pedestrian railing system on the south side of the sidewalk.
2013: Modifications to the motor controls and traffic gate and signals electrical hardware.
2016: Installation of new pedestrian railings on the southeast and southwest wingwalls; repairs to the southeast and southwest training walls; installation of chain link fences on the southeast and southwest embankments and at the westbound traffic barrier.
2017: Replacement of the span locks, the east end of leaf truss bottom chord 0S-2S, and bottom chord gusset plate and bearing plate at 0N; installation of buffers on the east abutment/rest pier; replacement of deck grating panels C and D between FB10 and FB12; and installation of a new armouring angle at the east end of the deck; strengthening of diagonal members 9N-12N and 9S-12S; strengthening at the base of vertical members 13N-14N and 13S-14S.
2018: Refurbishment of the keyways of the north guide assembly pinion keys and pinion shaft; replacement of the drive motors and modifications to the motor control system; localized repairs to the deck grating.

5. Work Completed Since Last Detailed Inspection

The following work has been completed since the 2018 Comprehensive Detailed Inspection was carried out in October 2018:

October 2019: Removal of loose concrete debris from counterweight.
February to March 2020: Installation of steel plates over cracked areas at the west end of the deck grating; repairs to the north steel armouring angle on the east ballast wall.
March to August 2020: Replacement of failed counterweight trunnion sleeve studs. Replacement of counterweight trunnion bearing and second link bearing lube lines. Installation of over-travel bumper blocks.

6. Inspection Methodology

Due to abnormally high water levels restricting access to the below deck components, Parsons carried out the Comprehensive Detailed Inspection (including the fatigue inspection, east approach and abutment survey, and detailed grating inspection) of the Bascule Bridge in two phases. Phase 1 was performed from Wednesday August 14th to Friday August 16th, 2019 and included the inspection of above-deck components only. Phase 2 was performed from Wednesday October 23rd to Friday October 25th, 2019 and generally included water-based access and diving operations. A limited condition survey of the concrete slab soffit of the mechanical room was included as part of the scope of this project and was carried out by Parsons sub-consultant Bridge Check Canada Ltd. (Bridge Check) on August 18, 2019. The mechanical and electrical inspections were both carried out by Stafford Bandlow from Tuesday August 27 to Wednesday August 28, 2019. The mechanical inspection also occurred on Thursday August 15, 2019. The inspections were carried out in accordance with the PSPC *Bridge Inspection Manual* (BIM), the current edition of the CHBDC, the Federal Highway Administration (FHWA) *Inspection of Fracture Critical Bridge Members* supplement, and the AASHTO *Moveable Bridge Inspection, Evaluation and Maintenance Manual*. Safety measures were implemented as per the Occupation Health and Safety Act (OHSA) and the MTO *Safety Practices for Structure Inspection* manual. Prior to the commencement of the field work, a Traffic Management Plan and a Site-Specific Health & Safety Plan were prepared and submitted to PSPC for review. A copy of the plans was kept on site at all times with the inspection team.

A provisional item was included in this assignment; the accumulation of deleterious debris (such as disintegrated concrete and organic material) on the sheet metal angles at the base of the counterweight cladding was noted during previous inspections, which causes a potential hazard due to the possibility of material falling onto the passing vehicles. If the current CDI revealed a significant amount of debris present, the provisional item to remove the debris would be activated; the current CDI did indeed reveal that the removal of the debris was necessary. This work was completed overnight, starting at 10:00 pm Wednesday October 30 and ending at 6:00 am Thursday October 31, 2019. See Appendix F for a detailed Memorandum pertaining to this work.

Structural Inspection

The structural inspection of the bridge consisted of a close-up, detailed visual inspection of all exposed surfaces of the above-water, above-grade, and a Level 1 underwater inspection of submerged components. Above-deck leaf truss components, main trunnions, tower truss members, operating struts, counterweight, and lower sections of the mechanical room were observed from the deck and sidewalk surfaces and by using an articulated man-lift supplied by Sunbelt Rentals. The inspection of the below-deck superstructure components over water was performed using a motorboat supplied and operated by ODS Marine. The inspection of the underwater components was performed by a dive team from ODS Marine and supervised by a Parsons Engineer.

The counterweight truss and upper sections of the tower truss were inspected from the stairways, catwalks, and ladders located on the structure, and by Parsons' certified Rope Access Technicians. Additional rope access support and equipment was provided by Team Industrial Services Inc. The fatigue inspection was carried out by a team comprising a Parsons engineer, and non-destructive testing (magnetic particle testing) specialists from Brouco NDT Inc. The east approach slab and east abutment survey field work was carried out by surveyors from Annis O'Sullivan Vollebekk Ltd.

Traffic control measures for the temporary alternating lane closures (including signage and Traffic Control Persons, i.e. flaggers) required for the inspection, limited condition survey of the mechanical room slab, and counterweight debris removal were implemented in accordance with the requirements of the Ontario Traffic Manual, Book 7, and provided by Beacon Lite. Flood lighting for the counterweight debris removal was also provided by Beacon Lite.

The superstructure and substructure components were visually inspected to assess their condition in terms of general damage, deterioration, deficiencies and maintenance issues, with particular attention paid to the fracture critical and fatigue prone components of the bridge. Concrete components were hammer sounded and defects were recorded and mapped. Where possible, surfaces of the structure were inspected at close proximity, i.e. within arms' reach. All other structural and non-structural components were visually inspected, and their conditions were noted. Instruments such as calipers, pit gauges and ultrasonic thickness measuring devices were also used to measure section loss in steel members. Utilities were visually inspected for overall material condition and obvious potential safety concerns only.

The limited condition survey of the mechanical room concrete slab was performed during the same mobilization as Phase 1 of the inspection. An articulated man-lift supplied by Sunbelt Rentals was used to access the underside of the slab. No special access equipment was required to access the top of the slab. The limited condition survey included performing visual, surface deterioration, delamination, concrete cover, and corrosion potential surveys of the entire underside (soffit) of the slab. It also included visual, surface deterioration, and delamination surveys of the accessible areas of the topside of the slab (inside the mechanical room). Delaminations were tested through sounding of the concrete with a hammer. Seven field cores (75mm in diameter) were taken: three from the top and four from the underside. All cores and core holes were visually inspected for surface defects and repaired. The cores were logged and taken for laboratory materials testing. A summary of the surveys and laboratory testing results along with photographs of the defects, cores, and core holes are included in Bridge Check's report in Appendix I.

The provisional item to remove the debris from the cladding on the underside of the counterweight was carried out overnight using an articulated man-lift supplied by Sunbelt Rentals. The work involved removing the steel angle cladding at the base of the counterweight to permit access to the space between the soffit cladding and the concrete counterweight where the debris has been accumulating. The removal and replacement of the angle cladding and removal of the debris was performed by G.A.Wright & Son under the supervision of a Parsons engineer and PSPC (including a bridge operator). Debris was manually collected using a pry bar and various tools, and transferred to the bed of a G.A.Wright & Son pickup truck. The two doors in the east face of the cladding were opened to observe the quality of the concrete in the two chambers. The concrete was visually inspected, and hammer sounded to determine locations of disintegrated concrete. A detailed memorandum including photos of the work completed is shown in Appendix F.

Observations were recorded in the Field Observation Forms included in Appendix A, with new observations in blue text. Material and Performance Condition Ratings (MCR, PCR) for all elements were assessed using the specified rating criteria outlined in Part 2 – Inspections and Appendix A are summarized in Figure 2.2 of the BIM (see Figure 5). Results of the inspection were summarized on the standard BIM Inspection Form (included in the Inspection Summary Form section of each structure), where the rating of the component was based on Part 2 - Inspections, Section 2.2. Priority codes for repairs were assigned in accordance with Section 2.3 of BIM (see Table 1), and the structures were given an overall Structural and Functional Condition Rating in accordance with Section 2.4 (as summarized in Table 2 and Table 3.

Mechanical Inspection

The general scope of the mechanical inspection was as follows:

- Visual inspection of components of the mechanical systems for adequacy of lubrication, leakage, cracks, unusual noise, corrosion and wear.
- Visual inspection of drive system, including mounting bolts, machinery supports and anchorages, brakes, bearings, gear teeth, alignment etc.
- Visual inspection of mechanical components that stabilize the movable span when it is in motion and at rest.
- Visual inspection of span locks and drives, centering devices, live load supports, buffers, trunnion bearings and brakes.
- Observation of proper bridge operation, acceleration, deceleration, braking, and seating, including sequence of operation and interlocks.
- Monitoring of the bearings and other components for noise during operation.

All mechanical items were at a minimum externally visually inspected. Items such as bearings do not require disassembly unless issues are noted. Photographs of specific mechanical components and defects recorded by Stafford Bandlow are included in Appendix D.

Electrical Inspection

Every component of the electrical system was visually inspected for condition and adequacy to perform its intended function. The following describes the extent of the electrical inspection services provided:

- Traffic signals, gates & barriers were visually observed during operation. Proper sequencing, all lamps lighted, physical condition of enclosures, gate arms, hardware, wiring, conduits, mounting bolts, internal dirt & debris, corrosion, etc. were checked.
- Navigational lights were visually observed during operation. All lamps lighted, physical condition of housings, lenses, conduit & wiring, attachment bolts & hardware, corrosion were checked.
- Conduit, wiring, junction boxes and enclosures were visually checked for corrosion, adequacy of mounting/attachments, bolts and hardware, spare conductors, weathering of cable jackets and insulation, grounding, water-tightness, etc.
- Drive motors (both AC & DC) were visually checked for mounting bolts, frame movement, noise & vibration, shaft end play during operation, coupling/pulley/sprocket bolts, ventilation openings, dirt and debris build-up, cable connections, brushes, commutators/slip rings, load measurements. The drive motor current, voltage and power parameters were monitored and recorded during operation.
- General purpose motors were visually checked for mounting bolts, frame movement, noise & vibration, shaft end play during operation, coupling/pulley/sprocket bolts, ventilation openings, dirt & debris build-up, cable connections (when visible).
- Brakes were visually checked for overall operation, noise & vibration, wiring, limit switches, corrosion and dirt/debris build-up on electrical components, mounting hardware.

- Locks were visually checked for overall operation, noise & vibration, wiring, limit switches, corrosion and dirt/debris build-up on electrical components, mounting hardware. The lock motor current, voltage and power parameters were monitored and recorded during operation.
- Limit switches were visually checked for overall operation, free movement of lever arms & plungers, wiring, sprockets/chains/gears/couplings, corrosion, mounting bolts & hardware, condition of contacts (when visible).
- Control system (Console, Relay/PLC Cabinets, Speed Controls) was visually checked for condition of enclosures and cabinets, wiring and internal components mountings, dirt debris accumulation, noise, heat, safety (exposed terminals, etc.), grounding, functioning of indicator lights, switches, pushbuttons, and metering. Control system interlocking was tested.
- Submarine cables were visually inspected for their physical condition and quality of installation. Submarine cable junction boxes were also inspected along with the termination of the cables.
- Bridge operation was visually observed for proper operation, acceleration & deceleration, braking, drive motor current draw during operation, seating.

Photographs of specific electrical components and defects recorded by Stafford Bandlow are included in Appendix E.

6.1 Component Condition Ratings

In accordance with Part 2 – Inspections, Section 2.2 of the BIM, each component has been assigned a Condition Rating. Tables detailing specific material and performance related defects may be found in the same section of the BIM General guidelines for percentage reduction based on the severity and extent of material defects and on the reduction in capacity to perform its intended function are as indicated in Figure 2 below.

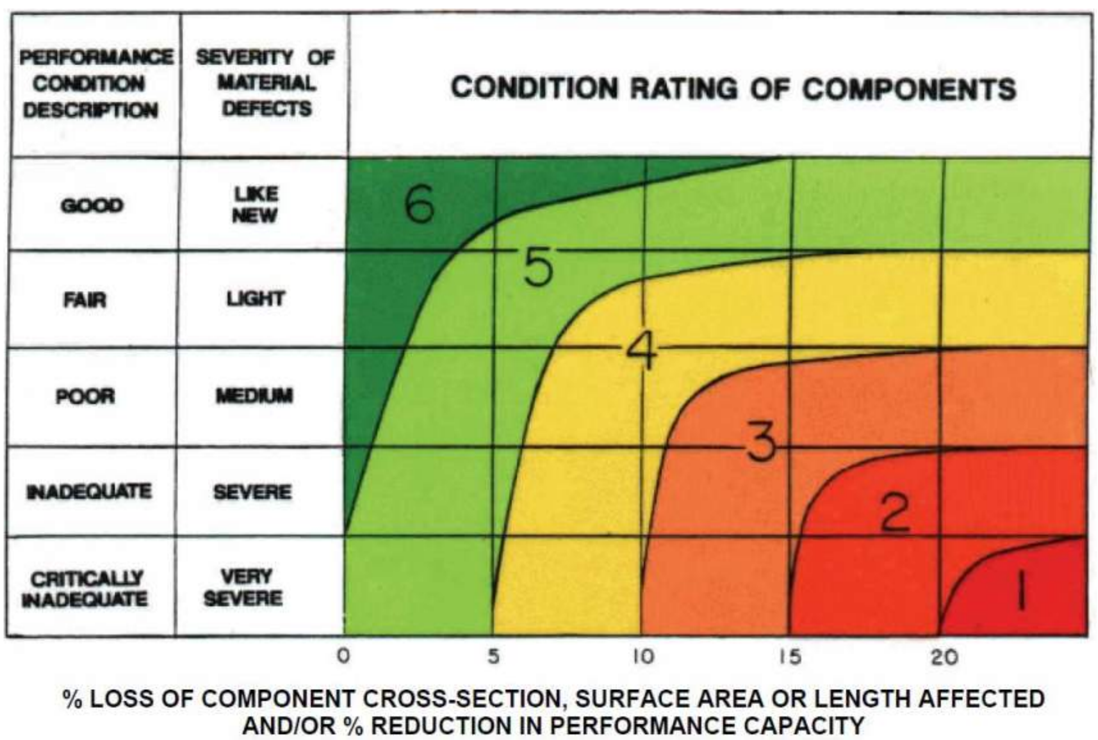


Figure 5: Figure 2.2 of the BIM - Condition Rating of Primary Components

6.2 Component Repair Priority Codes

In accordance with Section 2.3 of Part 2 of the BIM, the Priority Codes assigned to each component used in the rating forms are defined as follows:

Table 1: Excerpt from BIM Section 2.3 - Priority Codes for Component Repairs

CODE	DESCRIPTION
U	Urgent; requires immediate attention and remedial measures to ensure public safety
M	Required work to be done as part of routine annual maintenance
S	Further study/investigation/surveys required prior to initiating repair program
A	Repair and/or replacement to be done in less than 1 year
B	Repair and/or replacement to be done in less than 3 years
C	Repair and/or replacement to be done in less than 5 years
D	Condition to be re-assessed at the next inspection

6.3 Structural and Functional Condition Rating

In accordance with Part 2 – Inspections, Section 2.4 of the BIM, the structure has been assigned an overall Structural Condition Rating and Functional Rating in accordance with the criteria in Section 2.4 of the BIM, which are summarized below:

Table 2: Table 2.4(a) from BIM – Overall Bridge Rating: Structural Condition

RATING	CONDITION	OBSERVATIONS
6	Excellent	• New condition, minor imperfections – no repairs warranted; • Structure meets current CHBDC live loading and seismic requirements.
5	Good	• Structure meets current CHBDC live loading and seismic requirements; • Minor repairs required to secondary or auxiliary components; • Known problems relating to primary components but no repairs required; • Minor touch up coating required.
4	Fair	• Structure meets current CHBDC live loading; • Minor repairs required to primary components; • Significant repairs may be required to secondary or auxiliary components; • Minor scour problems; • Significant touch up coating required – no rust holes.
3	Poor	• Structure does not meet current CHBDC live loading; • Posted to within 15% of CHBDC live loading; • Repairs required to primary components and/or load carrying capacity is not compromised; • Medium scour problems; • Rust holes limited to secondary or auxiliary members.
2	Inadequate	• Structure does not meet current CHBDC loading; • Load posted more than 15% below CHBDC loading; • Significant scour problems; • Significant repairs and strengthening required to primary components to reinstate load capacity.
1	Critically Inadequate	• Inadequate to support vehicular loads; • Possibility of imminent failure; • Structure has failed or is closed to traffic; • Public safety is of concern.

Table 3: Table 2.4(b) from BIM – Overall Bridge Rating: Functional

RATING	CONDITION	OBSERVATIONS
6	Excellent	• New condition, minor imperfections – no repairs warranted; • Structure meets current CHBDC live loading and seismic requirements; • Structure meets TAC width and vertical clearance requirements; • Crash tested barriers at bridge and approaches – meet current requirements; • Traffic Capacity Level of Service: C; • Riding quality – excellent; • Approach geometric conditions meet current standards.
5	Good	• Structure meets current CHBDC live loading requirements; • Structure meets TAC width and vertical clearance requirements; • Crash tested barriers at bridge and approaches – meet current requirements, minor repairs required; • Traffic Capacity Level of Service: C; • Riding quality – Good; • Approach geometric conditions: Minor variations from current standards but generally acceptable.
4	Fair	• Structure meets current CHBDC live loading requirements; • Deficiency in terms of bridge width and/or vertical clearance per TAC requirements is less than 10%; • Approach or Bridge barriers do not meet current standards; • Repairs required at multiple locations (<20 percent); • Traffic Capacity Level of Service: D; • Riding quality – Fair; • Bridge or approaches posted at 10 km/hr below the normal highway speed; • Approach geometric conditions deficient in terms of horizontal or vertical alignment.
3	Poor	• Structure does not meet current CHBDC live loading; • Load posted to within 15% of CHBDC live loading; • Deficiency in terms of bridge width and/or vertical clearance per TAC requirements is more than 10%; • Approach and Bridge barriers do not meet current standards; • Repairs required at multiple locations (>20 percent but <50%); • Traffic Capacity Level of Service: E; • Riding quality – poor; • Approach geometric conditions deficient in terms of horizontal and vertical alignment; • Bridge and approaches posted at 20 km/h below normal highway speed.
2	Inadequate	• Structure does not meet current CHBDC loading; • Load posted to more than 15% below CHBDC loading; • Deficiency in terms of width and/or vertical clearance per TAC requirements is more than 20%; • Non crash tested barriers, deficient in terms of original design strength requirements and/or more than 10% in terms of height requirements. Repairs required at multiple locations (>50 percent); • Riding quality – very poor; • Traffic Capacity Level of Service: F; • Approach conditions deficient in terms of horizontal and vertical alignment; • Speed restrictions – posted at more than 30 km/h below normal highway speed.
1	Critically Inadequate	• Inadequate to support vehicular loads; • Possibility of imminent failure; • Structure has failed or is closed to traffic; • Public safety is of concern.

7. Structural Inspection Summary Form

NAME:	Bascule Bridge
LOCATION:	LaSalle Causeway, Kingston, Ontario
YEAR CONSTRUCTED:	1917
TYPE OF INSPECTION:	Comprehensive Detailed Inspection

Original Design:	The Strauss Bascule Bridge Co., 1914
Drawings Available:	Yes
Previous Inspection Report Date:	2018 Comprehensive Detailed Inspection Report (November 2019)
Author:	Parsons Inc.
Current Inspection Date:	Structural: August 14 – 16 and October 23 – 24, 2019 Mechanical: August 15, 2019, and August 27 – 28, 2019 Electrical: August 27 – 28, 2019
Inspectors:	Structural: B.Wood, P.Eng.; J-B.Charron, P.Eng., ing.; B.McAuley, P.Eng.; D.Voltchek, EIT.; S.Willows; J.Struthers; (Parsons Inc.) D. Harper, CWI (Brouco NDT Inc.) Mechanical: M. Broglie, PE; R. Giernacky, PE (Stafford Bandlow Engineering) Electrical: Y.Zhang, PE (Stafford Bandlow Engineering)
Temperature:	August 15 – 16: 13 to 26°C (variable) August 27 – 28: 19 to 23°C October 23 – 24: 7 to 16°C (variable)
Weather:	August 15 – 16: Clear to cloudy with light rain (variable) August 27 – 28: Cloudy October 23 – 24: Mostly cloudy, occasional light rain (variable)
Special Access Equipment:	Work boat; Man-lifts; Rope Access equipment; Alternating single lane closures.
Previous Overall Rating: Structural:	3 (*Cracks in primary truss members, connections, and stringers; significant repairs required to primary and secondary components, including counterweight and deck grating; structure does not meet current CHBDC special load cases for moveable bridges*)
Current Overall Rating: Structural:	3 (*Cracks in primary truss members, connections, and stringers; significant repairs required to primary and secondary components, including counterweight and deck grating; structure does not meet current CHBDC special load cases for moveable bridges*)
Previous Overall Rating: Functional:	2 (*Approach guide rails do not meet current MTO standards; bridge barriers do not meet current CHBDC crash-tested requirements; roadside and vertical clearances and sidewalk width do not meet TAC requirements; riding quality is poor*)
Current Overall Rating: Functional:	2 (*Approach guide rails do not meet current MTO standards; bridge barriers do not meet current CHBDC crash-tested requirements; roadside and vertical clearances and sidewalk width do not meet TAC requirements; riding quality is poor*)

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Leaf/Through Truss (P)	2	2	S, A

Top Chord: **0N-1N** has pitting up to 4mm deep in the web near 1N representing an overall 6% loss of cross-sectional area, and a small gouge caused by impact damage 2.3m above the deck. Impact damage to the south bottom flange of **13N-16N** was found to have a 3mm long crack (which was later ground out). 5mm deep pitting in the top of the south flange 2m above deck level, and various other areas of medium to very severe pitting was also noted. **0S-1S** has several locations of localized severe pitting in the north web above and below sidewalk level (**Photo S11**), up to 50% localized section loss of lattice elements, and 40% section loss of rivet heads at bottom plate at 1S. Member **1S-3S** has very localized medium to severe pitting of the interior of the inner bottom flange at the interface with the web at 1S. A total of nine areas of lamination defects in the steel, and four cracks ranging in size from 3mm to 41mm were also noted (**Photos S-12, S-13**). Member **3S-5S** has 80mm long lamination defect in the south face of the north channel with a crack 60mm long parallel to the main stress in this primary tension member (**Photo S14**). An additional crack 50mm long parallel to main stress, and a diagonal crack 10mm long were also found near the lamination defect. The diaphragm inside member **11S-13S** near node 13S is perforated and has widespread severe pitting (**Photo S15**). Several small perforations and severe section loss were noted in the bottom batten plate and lower flange of the inner channel of **13S-16S** at 16S.

Bottom Chord: Localized areas of light to severe pitting throughout. Severe localized section loss of bottom chord flanges and rivet heads at sidewalk floor beam connections and moderate to severe pitting is typical. Member **14N–16N** has a perforation in the south web near node 16N and a section of coating is missing permitting light corrosion to develop (**Photo S16**). There is severe localized pitting and minor rust jacking in members **14N-15N** and **14N-16N** at the interface between them (**Photo S17**). The rust-jacking is minor and appears to have been present for a while. There is severe localized section loss and a perforation with an area of 10mm^2 in the web of the south channel of member **0S-2S** at node 2S adjacent to the sidewalk floor beam connection (**Photo S18**). Member **46-6S** has severe localized section loss at the base of the south web at the connection to FB4 (**Photo S19**). **14S-16S** deformed prior to the replacement of the lattice members with cut-out plates, though it appears the member may have deformed further following this repair (**Photo S20**). The member has two perforations and a 12mm long vertical crack perpendicular to the main stress in the interior channel web (**Photo S21**). Severe localized pitting and section loss of the flanges where 14S-16S and 14S-15S intersect was noted, with an area of 1,400mm^2 having 100% section loss. 13 rivet heads in the outboard channel connection to 16S have over 75% section loss (**Photo S22**). Member **14S-15S** has two perforations and multiple cracks in the bottom batten plate near node 15S. The cracks range in length from 3mm to 11mm (**Photo S23**). There is severe localized section loss (50 to 100%) and knife-edge corrosion of both bottom flanges over 1m near node 14 where members 14S-16S and 14S-15S intersect. Light to medium active corrosion was also noted in these areas, in the interior web near 15S, and at the top plate near 16S.

Diagonals: The diagonal members are in generally good condition, but many members at and below deck level have severe localized section loss of flanges (particularly at lattice locations), webs and rivet heads with severe pitting and perforations noted in the members and connecting plates. Member **12N-13N** is deformed into an S-shape in the upper section near 13N (**Photo S24**). Pitting has caused up to 70% localized section loss (6mm deep pitting in 1 flange) of the bottom flange at the base of member **9S-12S**. The upper batten plate of member **12S-13S** near node 13S is deformed (**Photo S25**) and there is localized 6mm deep pitting (up to 50% localized section loss) in the bottom flange at lattice locations in the lower section of the member.

Verticals: Member **1N-2N** has a crack at a flame-cut hole in the southeast angle and the outstanding leg of the southwest angle is bent above the bottom chord (**Photo S26**). There is a flame-cut hole in the northwest and northeast flange of **9N-10N**, but no cracks were found. The flange below the northwest flame-cut hole was observed to be bent in the 2018 CDI but was not observed during the current inspection. Very severe pitting with a small perforation was noted in the south angles above node 10N (**Photo S27**) and impact damage to the member above the railings has bent a portion of the southeast flange. Both south flanges of vertical member **11N-12N** near 12N are perforated but the member has been strengthened (**Photo S28**). Bolts used in the repaired section

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
on member 13N-14N are too short (Photo S29). Impact damage on north side of member 1S-2S has caused the northwest flange to be slightly bent and caused damage to the coating allowing light corrosion to occur (Photo S30). Pitting up to 6mm deep of inside flange thickness of 3S-4S noted at sidewalk level, and up to 50% cross-sectional loss of some lattice and the underside of the angles at lattice locations. 9S-10S has a 3mm long crack in the top of the southeast flange at a previous weld location (Photo S31). 11S-12S has pitting 6mm deep representing up to 80% localized cross-sectional loss of the flange thickness below sidewalk level. Using magnetic particle testing, no crack was detected in the flame-cut hole in the northeast angle of 13S-14S at the bolt approximately 2m above the roadway. Impact damage was also noted to the inboard flanges of vertical members 7N-8N, 5S-6S, and 7S-8S. The other vertical members are in generally good condition overall, but many members at and below deck level have severe localized section loss of flanges, webs and rivet heads.			
Tower Truss (P)	2	2	A
The interior of member 15N-17N has severe corrosion and section loss of the rivet heads at the base at 15N due primarily to the standing water at the base of the member (Photo S32). The standing water has also led to an area of 100% section loss of the stiffening angles and gusset plate at node 15N, and of the bolt heads from the trunnion. Member 15N-18N has moderate to very severe pitting of the channel flanges at lattice locations and at the base of the web, a perforation in the inner channel at mid-span, area of section loss of the north bottom flange at 15N, and 4 rivet heads have 90-100% section loss at node 15N (Photo S33). The west interior angle near the base of member 17N-18N has localized pitting up to 4mm deep. Diagonal member 17N-19N has up to 50% localized section loss of the inner vertical components at 19N. Three holes were cut in the bottom outside flange of diagonal member 17N-21N near node 17N, and bottom outside flange is also bent near node 17N. 18N-19N has severe section loss of the interior channel flanges and 20 rivet heads and perforations in the upper and lower batten plates at node 19N (Photos S34 and S35). There is an additional perforation in the inner channel at mid-span. Vertical member 19N-20N has severe section loss in the rivet heads and web plate at roadway level and deformation (likely due to impact damage) in the southeast and southwest flanges (Photo S36), and additional deformations in the northeast and northwest flanges at machinery room level. The lower connection at 15S traps water inside 15S-17S causing severe pitting in the interior of the members and many of the rivet heads exhibit severe section loss. There is up to 20% localized section loss of the underside of the bottom flange at lattices near base of member and up to 100% localized section loss of the interior web at 15S at location of active corrosion. There are two 3mm long cracks emanating from a perforation in the south channel of 15S-18S (Photo S37) and areas of up to 80% localized section loss of the bottom flange thickness and up to 70% section loss of rivet heads were noted. There is a 70mm long crack emanating from three perforations in the south channel of 18S-19S (Photo S38). The member also exhibits 5mm pitting in the bottom flange and rivet heads at node 18S and localized 10-20% section loss around rivet heads throughout the member. Vertical member 19S-20S has 70% localized section loss of 6 rivet heads at the base of the member and impact damage to the southeast and southwest flanges above road level (Photo S39). Light to severe pitting, and active corrosion are typical in most tower truss members.			
Counterweight Truss (P)	2	2	S, A
Member 21N-27N has a crack through the full width of the outstanding leg of the bottom interior angle at 27N (Photos S40 and S41); no change in crack length since last report. The angle is riveted to the web plate, so the crack cannot propagate into the web of the built-up member. The east bottom batten plate of 22N-23N has severe pitting along its edges, a small perforation and is holding water. Member 21N-22N has localized area of pitting 2-7mm deep with a perforation above the lowest rivet in the lower batten plate on the south side (Photo S42). This member also has pitting 2mm deep in the north and south bottom angles at the first stiffener, and localized 3mm deep pitting in the batten plate at this location with severe section loss of four rivet heads. 21S-27S has localized severe pitting up to 12mm deep in the north bottom angle at the west end and 40% section loss of the last rivet head. 2mm deep pitting was noted in the bottom angles of 21S-22S at the first stiffener. Debris and water are collecting on member 26N-26S (Photo S43). Light to severe pitting typical in most members.			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Counterweight Links (P)	5	5	D
The counterweight link members **13N-22N** and **13S-22S** are in generally good condition but do exhibit localized pitting in the flanges at some lattice locations.			
Operating Struts (P)	5	5	D
Both the operating struts have been heavily reinforced, and lattice has been replaced with cut-out steel plates. Pitting up to 5mm (**13S-17S**) and 2mm (**13N-17N**) deep was noted at edges of inner web plate but reinforcing plates have been added to outside face to strengthen member. Coating on the top flange and on the web has been damaged by the operation of the bridge.			
Operating Pinion Struts (P)	5	5	C
The transverse struts directly below the operating pinion at both **17N** and **17S** exhibit localized moderate to severe active corrosion on the bottom flanges inside the mechanical room housing (**Photo S44**). Outside of the housing the members exhibit severe pitting and section loss but have been cleaned and coated and therefore no ongoing corrosion. Upper stiffeners are bent.			
Primary Component Connections (P)	2	2	A
Main Trunnion Connections: Connections include all gusset plates at nodes 15 and 16 and members 15S-16S and 15N-16N but does not include the trunnion collar plates at 15S/N nor the vertical gusset plates connecting Tower Truss members 15S-17S and 15N-17N. The configuration of the connections traps water inside tower truss members 15S-18S and 15N-18N and as a result the head end of the four bolts that secure the trunnion bearings housing to the structure have 100% section loss due to corrosion. **15N/16N:** There is a 15mm vertical crack propagating from a large perforation at the base of the inside vertical gusset plate between the end of 14N-16N and FB16 at 16N parallel to the shear stress affecting capacity (**Photo S45**). The remaining thickness of the plate above the perforation was determined by UT to be as low as 3mm. The south face of the interior vertical gusset plate has 3mm pitting at the interface with the top flange of 14N-16N. 6 rivet heads at the base of the interior face of the south vertical gusset plate between the end of 14N-16N and FB16 at 16N have very severe section loss (**Photo S46**). The interior plate of the south triangular member behind FB16 has three perforations and 10 to 12mm section loss adjacent to the connecting clip angles (**Photo S47**). Severe pitting was also noted in the clip angles. There is a large perforation in the west transverse built-up plate (only visible when the bridge is in the open position) between the vertical gusset plates (**Photo S47**) and very severe section loss in the rivet heads and angle at the base of the exterior face of the south plate (**Photo S48**). **15S/16S:** The north vertical gusset plate has a perforation and a 3mm long crack in the east edge immediately above the north top flange of bottom chord 14S-16S (**Photo S49**). The north face of the plate has pitting at the interface with 14S-16S with a remaining thickness as low as 5.7mm. There are perforations at the base of the north and south vertical gusset plates between the end of 14S-16S and FB16 at 16S. 13 rivet heads at the base of the interior face of the south vertical gusset plate at the end of 14S-16S have around 75% section loss, and the base of the gusset plate has severe pitting (**Photo S50**). The exterior face of the south vertical gusset plate has 6mm pitting (50% section loss) at the interface with the top flange of 14S-16S. The exterior plate of the north triangular member behind FB16 has a large perforation at the base of the original plate. Additional perforations have been repaired by the addition of a welded plate. The upper section of the north (roadside) plate adjacent to the trunnion collar has widespread severe pitting. UT measurements indicate remaining thickness generally between 6.6mm and 9.6mm (original thickness was 12.7mm) with one location (at top of plate next to trunnion collar) of 3.3mm (**Photos S51 and S52**). The rivets at the base of the north vertical gusset plate at the end of 14S-16S at 16S have been replaced with bolts, and there is widespread 2mm pitting in the south face of the plate. *Refer to the deterioration drawings in Appendix B for more details.* **Leaf Truss Connections:** The upper connections of the leaf truss are in generally good condition. At **13S** the upper batten plate and outboard gusset plate connection to 12S-13S are bent, there is a perforation of the end stiffener/diaphragm within the connection, and coating failure on the gusset plate connecting member 13S-13N.			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
The inboard gusset plate of **2N** has delaminated into two segments above the bottom chord on the west and east sides over the full height of the plate. Full-width cracks were identified in both the east and west sides of the gusset plate (**Photo S53**). The bottom horizontal gusset plate at node **10N** has an area of 2000mm^2 of section loss and a perforation (**Photo S54**). **12N** has up 60% section loss of the inboard gusset at the top flange of the bottom chord, and 50% section loss on the east side of the inboard gusset plate along the floor beam connection. Pitting ranging from 1mm to 6mm deep was typically noted in the gusset plates along the top flange of the bottom chord members. Up to 4mm deep pitting noted in clip angle at connection with sidewalk floor beam at **10N**, **2S**, **4S**, **6S**, **8S**, **10S**, **12S** and **14S**. **Tower Truss Connections**: The inboard gusset plate at node **15N** has localized pitting between 2mm and 7mm deep representing up to 70% loss of cross-section of the plate, four perforations, and 80% loss of a rivet head at roadway level (**Photo S55**). Water is trapped inside the connection. The short column below 15N (only visible when the bridge is the open position) is in generally good condition. Node **18N** has up to 50% localized section loss of the gusset plates and active corrosion along the top flange of members 15N-18N and 18N-19N with a 5mm perforation noted on the inboard gusset plate. Node **19N** has moderate to localized severe pitting representing 30-70% section loss of the plates along the vertical flange of 19N-20N and along the underside of the bottom flange of 18N-19N, plus three perforations. Some rivet heads at the base of the gusset plates have between 50% and 95% section loss. There is active corrosion at the base of the interior face of the inboard gusset plate. The inboard gusset plate at node **15S** has severe pitting 7mm deep with a perforation above 15S-14S, with active corrosion. At least 10 rivet heads have 50% to 90% section loss. Node **18S** has 40% severe section loss in the interior of the gusset plates along the top flange of members 15S-18S and 18S-19S plus a small perforation. Light to severe pitting in all members except for **20N** (member in good condition). **Counterweight Truss Connections**: The counterweight truss connections are in generally good condition. *Rating is based on the PCR of 2N, 15N, 14S, 15S, and 18S.*			
Floor System (P, S)	1	1	S,A
Floor Beams (P): The roadway floor beams are in generally good condition, however localized deformation of the web of up to 16mm from straight was noted in **FB8**, **FB10**, **FB12**, and **FB14**. The deformation in **FB8** is causing a gap between Stringer E and top flange of **FB8**. Localized light corrosion was noted on **FB0**. The sidewalk floor beams typically have localized areas of medium to severe pitting of the bottom flange, web, and rivet heads at the connection to the south truss (**Photo S56**). **Stringers (P)**: Peeling or flaking coating is typical at most members. The stringers are in generally good material condition apart from at the floor beam connections where numerous notches/cracks propagating from the 90-degree coping details were noted, some of which appear to have progressed since the 2018 inspection: FB0-FB2: stringers B, E (**Photo S57**), and F (bottom cope); stringer A (top cope); FB2-FB4: stringers E, F (**Photo S58**), G, and I (bottom cope); FB4-FB6: No notches/cracks noted. FB6-FB8: stringers F, G, and H (bottom cope); FB8-FB10: stringer E (bottom and top cope); FB10-FB12: stringers E (**Photo S59**), G, and I (bottom cope); stringer F and H (top cope); FB12-FB14: stringers F and G (bottom cope); stringer E (top cope); FB14-FB16: stringer D (bottom cope) (**Photo S60**); stringers E (**Photo S61**), F, G, H, and I (bottom and top copes). **Sills (S)**: The majority of the sills have permanent dead-load deflection creating a gap between the sills and deck grating (**Photo S62**). There is a 6mm gap between the sills and stringer F between FB14-FB16 (**Photo S63**). Several anchor bolts connecting the sills to the stringers were noted to be missing, loose or severely corroded (**Photo S64**). There is widespread light corrosion on the top flange of the sills where the coating has failed. *The rating of the Floor System is based on the MCR of stringer E between FB0-FB2.*			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Concrete Counterweight and Housing (P)	3	2	B
All except the north and south faces of the counterweight are covered with what appear to be corrugated metal roofing panels. Damp staining, large areas of light corrosion, and impact damage were noted on the panels on the underside of the counterweight (**Photo S65**). Gaps in the panels are permitting smaller pieces of aggregate from the disintegrated counterweight concrete to fall onto the roadway below. The doors to the two lower chambers on the east side of the counterweight are in poor condition and are difficult to open and close, and the hinges are also in poor condition and loose. The concrete in the two lower chambers exhibits spalls, disintegration, map cracking, efflorescence deposits and wet stains (**Photo S66**). Sounding of the concrete in the two lower chambers revealed the presence of deep concrete disintegration particularly on the south face of both chambers. Two new small perforations were noted adjacent to the repaired sections of the panels below the chamber doors. The sections of the bottom face of the counterweight visible though gaps in the panels exhibits efflorescence deposits, wet staining, and exposed corroded rebar and wire mesh (**Photos S67, S68**). The two upper chambers in the top face of the counterweight contain concrete blocks and catch basin lids used as ballast. The concrete in the upper chambers exhibits spalls, disintegration, and wet areas (**Photos S69 and S70**). The hatch covering the north upper chamber has a broken screw on the east side. The steel plates covering the north and south faces are in good condition overall although light pitting occurs throughout, and some localized areas of deep pitting were noted, particularly in the north plate near node 26N (**Photo S71**). Some nuts on the ends of the tie rods are loose or are missing. Disintegrated concrete has collected between the concrete and the metal panels, with most of the debris occurring in the northeast corner (**Photo S72**). The remaining areas had lesser accumulations of debris, though all areas had some amount of debris. The removal of the accumulated debris was warranted due to the high risk of the material falling onto the roadway below, possibly striking vehicles. The total amount of debris removed is estimated to be about 45 to 70 kg (100 to 150 lb.) (**Photo S73**). *Refer to the Counterweight Memorandum in Appendix F for more information. Condition Rating has been downgraded to reflect widespread ongoing material defects.*			
Structural Steel Coating (P, S)	5	5	B
Although the current coating system was applied during the 2009/2010 rehabilitation, localized defects are evident at numerous locations. Defects noted include cracking (coating-related), under-film corrosion and peeling (adhesion-related), and pinholing, edge defects, runs, and sags (application-related). Physical damage in the form of chips and scrapes was also noted. Small areas of touched-up coating are typical throughout the structure. The coating on the counterweight truss members is in generally good condition, although cracks were noted in the coating on the members and connection between nodes 21-27. The coating on the tower truss members above roadway level is in good condition. Most members at roadway level exhibit localized areas of active corrosion due to the absence of coating. The coating on the upper sections of the leaf truss members, connections, and bracing is in good condition but chips in the coating at locations of impact damage has permitted light corrosion to develop, and some small edge defects were noted. There are many scrapes and chips down to the steel evident in the verticals, diagonals, and top chord members at roadway/railing level. Coating defects noted on members below deck level include cracks (stringers), flaking/peeling (stringers, bracing, and bottom chords (**Photo S74**)), and bleeding and edge defects (bottom chords and connections). Pinholes in the coating over the top half of many stringer webs were noted and the complete loss of coating over a large area of the inboard channel of bottom chord member 14N-16N (**Photo S16**). The poor coating application on the recently rehabilitated span lock mechanisms and live load supports is a contractual deficiency.			
Deck Grating (P)	3	2	A
The coating of the grating has typically deteriorated, and the steel grating has light corrosion on the vertical faces of the cross bars and bearing bars and medium corrosion along the north and south edges (**Photo S75**). Bent and/or cracked (**Photos S76**) bearing and cross bars were observed throughout the grating, and broken bars were observed mostly at the west and east ends (**Photo S77**) with some broken bars occurring in the middle. Cracked bar-to-bar and bar-to-sill welds were noted at several locations (**Photo S78**). Various locations of bearing and cross			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
bar steel repairs were noted (**Photo S79**). Grating panels C and D in bay 10-12 were replaced with new galvanized panels in 2017 but not all bars were welded to the sills, and some welds have cracked. Two groups of cracked longitudinal bars were noted at the intersection of Panels 15-16 A and B and Panels 15-16 C and D. A new armouring angle was recently installed in 2017 on the east end of the deck grating which eliminated the elevation difference between the deck and the east approach armouring. The serrated edges have been completely worn away within the wheel tracks in each lane (**Photos S77 and S78**), significantly reducing traction and increasing vehicle braking distances. Concrete was noted in some voids at the east end of the deck (**Photo S79**). *Refer to the deterioration drawings in Appendix G for more information. Condition Rating has been downgraded to reflect ongoing material defects and performance deficiencies.*			
Pin and Hanger Bearings (P)	3	3	S, A
Main Trunnion Bearings: There is contact between the moving structure and the fixed structure in the vicinity of the main trunnion bearings during operation of the bridge (**Photos S80, S81 and S82**), creating a wear step in the tower leg and wearing away the heads of the rivets in the area. The contact is at the outboard side at both bearings and may be a result of contraction of the bridge due to temperature. Four mounting bolts at each main trunnion bearing have failed due to corrosion and should be replaced. Active corrosion was noted on the back (west) side of the north and south trunnions. The south (roadway) side of the north trunnion (**15N**) and the north (roadway) side of the south trunnion (**15S**) (**Photo S83**) have localized pitting of up to 3mm in the 31mm-thick collar plates, and up to 50% (15N) and 75% (15S) section loss of some rivet heads. The head ends of four of the mounting bolts for the main trunnion bearing have 100% section loss due to corrosion at both the north and south bearings. The north trunnion bearing exhibits minor fretting corrosion, indicating movement at the connection interface. No cracks were detected. Some areas of localized light corrosion on the north side of the south trunnion. **Counterweight Trunnion Bearings**: The sleeve studs used to secure the bearing sleeves to the structure are not tight at some locations. There is strong evidence that there is at least one broken sleeve stud: the top east stud at the outboard side of the north trunnion. Based on paint removal, it appears that there has been an attempt to tighten them, but that this was unsuccessful. Maintenance personnel have previously indicated that they used a hammer to drive one of the north counterweight bearing studs in while operating the bridge. This is an indication that the stud has sheared. The results of the phased array testing performed during the 2018 CDI indicate corrosion is present on the upper surface of both the north and south shafts. The south counterweight bearing has two missing lube fittings on the inboard side and a leaking fitting on the east most side of both the inboard and outboard sides. At the north counterweight bearing, one lube fitting is missing on the outboard side. *Note that the mechanical repairs contract completed in 2020 replaced all broken sleeve studs and replaced the lubrication fittings.* **First Link Pin Bearings**: Both the north and south bearing assemblies are inaccessible for hands on inspection as they are surrounded by structural steel. The only accessible portions of the assemblies are the nuts which secure the link pin. Externally the first link pins appear to be in good condition, and lubrication appears to be recent. There is cracked paint between the inboard and outboards nuts and the structure at both link pins, which may be an indication of slight movement. **Second Link Pin Bearings**: The lubrication fittings for the north and south pin are piped together which is not proper practice, and two of the three inboard lubrication ports for the north pin are leaking. As a result, the lubricant is probably not getting to the intended location(s). Evidence of movement at the inboard bearing for the south operating strut at the second link pin as there is some light paint cracking and fretting at the outboard and inboard hubs. *Note that the mechanical repairs contract completed in 2020 replaced the lubrication fittings.* *See the Mechanical Inspection section of the report for full details.*			
Abutments (P)	5	5	C
The majority of the abutment walls are not visible. A wide crack at the southeast end of the east abutment was noted near the sheet piles. The bearing seats are in generally good condition but there is an area of severe scaling			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
on the west bearing seat north of the truss, a shallow area of disintegration at the south end, and three spalls each with an area of about 300 mm^2 and 40 mm deep. The east bearing seat has a spall with an area of about 500 mm^2 at the northeast corner (Photo S84), and light areas of disintegration. Dirt and debris have accumulated on the east and west bearing seats. During high-water levels, both bearing seats are submerged (Photos S9, S10). The 2019 underwater inspection revealed erosion of the concrete wall with a height of about 300 mm and about 300 mm below the water surface at the east abutment, a triangular void with an area of 1000 mm by 800 mm and depth of 300 mm at the sheet pile/rip-rap interface at the south side of the west abutment (Photo S85), and some separation of the sheet piles of about 30 mm at the southeast corner of the west abutment. Some separation between the 3rd and 4th steel sheet pile panels from the north in the east abutment was noted. There is a plate behind the separation and is therefore no cause for concern. It was suspected that possible differential settlement of the east abutment has occurred. A surveying program was initiated in 2018 to determine if any settlement was ongoing, with 4 points established on the abutment. In comparison with the base data collected during the 2018 CDI, the elevations measured during the 2019 inspection are 0.005m higher, with one point being 0.006m higher than the 2018 elevations. These values are at the threshold of the allowable accuracy based on the methodology and precision of the equipment used. Therefore, there is no evidence of further movements of the east abutment. *Refer to Appendix H for surveying program data.*			
Foundations (P)	6	6	D
No evidence of foundation performance issues.			
Waterway (P)	5	5	D
No observed flow or navigation obstructions or embankment erosion. The seated limit switches on the east abutment were found to have water egress inside which may be a result of high tide and/or storm conditions. 590mm clearance from bottom of bottom chord measured on August 14, 2019. Very high water level at time of August 2019 inspection causing the east abutment to be submerged, and evidence of west bearing seat being submerged at high water level.			
Upper Cross Bracing (S)	5	5	D
The upper cross bracing members between the top chords of the leaf truss are in generally good condition, with defects typically limited to localized light pitting of angles near the connections, lower central batten plates, and rivets.			
Leaf Truss Lateral Struts (S)	5	5	D
The lateral struts between the top chords of the leaf truss are in generally good condition, with only localized light pitting of angles, lattice and rivets noted. Member 1S-1N has rust jacking between the top cover plate and flanges. Member 7S-7N has section loss less than 10% of 3 rivet heads on the north side.			
Leaf Truss Portals (S)	5	5	D
Member 1S-1N has impact damage to the lower west angle, and six lattices on the bottom and west side of the member are bent (Photo S86). The lower angle of 1S-1N is holding water (Photo S87). There is small perforation in the west angle at 1S and very severe section loss of the south batten plate and north gusset plate. There is a crack in the weld connecting the vertical clearance sign to the member. Member 13S-13N has 2mm deep pitting in the bottom chord and cross bracing, small perforations near 13S, localized severe section loss in the bottom gusset plate and south top chord, and many bent lattices in the bottom and top chords.			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Leaf Truss Sway Bracing (S)	4	4	C
The upper sway bracing members of the leaf truss are in generally good condition overall. The rating is based on the MCR of member **5S-5N** which has damage to the bottom angle above the westbound lane which has deformed the angle vertically by 38mm **(Photo S88)** and caused a global westward deflection. Minor impact damage was noted to the east bottom angle (20mm) and torsional deformation at the north and south ends of the top chord (10mm) of member **9S-9N (Photo S89)**. Localized coating failure and light corrosion has occurred at impact locations. There is a perforation in member **13N-13S** at 13S.			
Tower Truss Sway Bracing (S)	4	4	B
Rating corresponds to the MCR of the bracing member between nodes **20N-20S** and between **21N-21S**. The lower-west angle of **21N-21S** has numerous rivets with greater than 50% section loss, and the lower batten plate at the north end on the lower chord exhibits severe pitting and perforations. Member **20N-20S** exhibits 15% loss of cross-sectional area in most angles, 5mm deep pitting in the bottom east angle at 20S, 40% loss of cross-sectional area in angles and up to a 100% loss in batten plates at both the north **(Photo S90)**, and south **(Photo S91)** ends. Seven rivet heads on both the east and west sides near 20N have almost 100% section loss, and there is very severe section loss of four rivet heads on the east side of the bottom angle near 20S. Bent lattice in lower south section of member **17N-20N** near 17N was noted.			
Counterweight Truss Lateral Struts (S)	4	4	D
Rating corresponds to the MCR/PCR of the lower strut between **22N-22S**, and **24N-24S**. The west **21N-21S** (21-27 plane) strut has 20% localized section loss of the lower west and east angles over 1000mm at the north and south ends, 30% section loss in 5 rivet heads at the north end and 5 rivet heads at the south end, up to 20% localized section loss of gusset plates, and pitting 2mm deep in bottom angles and horizontal flanges. Although the center **21N-21S** (21–24 plane) strut exhibits severe deterioration (severe pitting and perforations in the angles, and up to 50% section loss of rivet heads) at the north and south ends, the deterioration appears to have occurred prior to the last coating contract and the member has also been strengthened at these locations though the strengthening plates do not connect to the lattice in both planes. The upper strut between **22N-22S** and the east strut between **21N-21S** (21-22 plane) are in generally good condition with only light localized 1-2mm deep pitting noted. The lower strut between **22N-22S** has 30% section loss of the lower east angle along its entire length with perforations at the south gusset plate connection, and perforations in the southwest batten plate and member end beyond connections. **23N-23S** has pitting of up to 2mm deep representing 20% localized section loss of the west angle bottom flange thickness at the north end, and the bottom west angle at 23S has active corrosion and perforations resulting in an area 10mm wide, 38-50mm long of section loss **(Photo S92)**. **24N-24S** has severe pitting and section loss in the bottom angles at 24S and 24N including a perforation of the east angle, and moderate pitting 2mm deep in bottom gusset plate at the west angle. The flanges at the north end of **25N-25S** are bent and pitting and 15% section loss of the angle at the bottom east on the north end, and bottom east and west in the south end were noted.			
Counterweight Truss Cross Bracing (S)	2	2	A
The counterweight truss bracing members are generally in good condition. The rating is based on the PCR of lateral bracing member **21S-27N** where a previous repair has not addressed the deficient connection of the lower angle to the gusset plate at 27N. The same member also has a localized area of severe pitting in the south bottom angle at the west end and severe section loss of a rivet head at this location **(Photo S93)**. At this location there are also perforations in the lower horizontal lower angle **(Photo S41)**. Member **21N-27S** has 50% section loss of horizontal upper leg at the northeast end, and lower vertical leg at the southwest end. Several other members have severe localized section loss of both angle legs and rivet heads due to moderate to severe pitting.			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Counterweight Link Lateral Bracing (S)	5	5	D
The counterweight link lateral bracing members are in generally good condition although localized pitting of 1mm deep was typically noted at the connections. The bottom flange of members **13.5N-13.5S** and **22N-22S** has up to 5% section loss of the thickness along the length of the member. The top north and south gusset plates of **13.5N-13.5S** are slightly bent.			
Lower Cross (Bottom Chord) Bracing (S)	4	4	D
The bottom chord bracing members are in generally good condition, however light to moderate pitting was noted at some connections and the underside of bracing members, and some members have coating failure. Rating is based on the condition of bracing member **10N-12S** which is severely deformed (**Photo S94**), including the deformation of the gusset plate at connection 10N and the lug angle at 12S from previous rust jacking.			
Sidewalk Floor Beam Bracing (S)	5	5	D
The sidewalk floor beam bracing members are sagging (**Photo S95**) but are in good material condition. Member **14S-16S** has an additional minor upwards deformation.			
Mechanical Platform and Housing (S)	4	4	U, M
The mechanical platform supports the drive motors and machinery and consists of structural steel members embedded in a reinforced concrete slab; the housing walls consist of corrugated steel panels; the flat roof system consists of steel framing members overlain by an asphaltic membrane and has three access hatches. The limited condition survey performed on the concrete slab revealed the underside of the slab to be generally in fair-to-poor condition. The concrete platform soffit has widespread light to moderate scaling, several localized areas of light honeycombing, light to medium spalls (some with exposed reinforcing), 9 clean medium cracks with a total length of 5.0m, and delaminated areas over traffic lanes (**Photo S96**). The top surface of the slab is in good condition with light scaling. The concrete in the extracted cores from the top and underside of the slab were found to be in good condition. A hole was noted in the web of the center structural steel beam. 50% to 70% section loss in the southeast angled brace bottom flange was noted. The top flange of the north motor support beam inside the mechanical room has 5mm section loss at the west end caused by water leaking into housing (**Photo S97**). The bottom flange of the east girder below the platform has localized 7mm pitting near the second from south cantilever catwalk support member. There is severe localized section loss and severe rust jacking in some of the other structural steel floor system members outside of the housing. The structural steel roof framing system is in generally good condition. During previous inspections, water was noted leaking into the housing on the north side, center, and northwest corner (**Photo S97**). A system of two metal trays leading to a bucket was installed to catch leaking water from the roof (**Photo S98**). There are several perforations in the corrugated steel panels at the northwest corner. There was a bird's nest with eggs present underneath the floor level, visible from inside the mechanical room at the south side at the time of the August 14th-16th 2019 inspection (**Photo S99**). *See 2019 Bridge Check Canada's report in Appendix I for more details on the concrete slab.*			
Deck Joints (S)	4	4	A
The joints at the ends of the deck are open, permitting dirt, debris and de-icing salts to collect on the substructure and superstructure elements below. The exposed top of the ballast walls typically exhibits moderate scaling and wear at the armouring angle and wide cold joints. A new armouring angle was recently installed on the east end of the deck grating which eliminated the elevation difference between the deck and the east approach armouring. Approximately 50% of the length of the west joint armouring sounds hollow, indicating either concrete delamination or a void between the armouring and the underlying concrete (**Photo S100**). The section of the east armouring to the north of the roadway centerline became loose in spring 2020 and a temporary repair carried out.			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Pedestrian Railings (S)	6	6	D
The pedestrian railings on the south side of the bridge sidewalk and on the southeast and southwest approach sidewalks are in good condition with no significant defects noted.			
Operator's House Railings (S)	4	4	D
The cast iron pipe railings between the Operator's House and the north trunnion were repaired in October 2018 to eliminate perforations at the base of two posts. East railing had temporary timber hoarding in front of it at the time of the inspection (**Photo S101**).			
Roadway Railings (S)	4	4	A
The thrie-beams and lattice railings are in generally good condition, but several bolts are missing from the splices in the thrie beams and there is localized light corrosion at the ends of both thrie-beams and the south railings. The post at the east end of the south railing has been anchored with lag bolts into sidewalk planks. The railings and thrie-beams are discontinuous above the main trunnions. On the south side this could allow pedestrians to fall into the roadway (**Photo S83**). The existing barriers do not meet current CHBDC crash-tested requirements (in terms of geometry and direct attachment to the truss) and could subject primary members of the main truss to damage or failure during vehicle collision along the barrier. The railings meet the CHBDC minimum height requirements for combination traffic/bicycle barriers.			
Curb and Sidewalk (S)	5	5	M, B
Curb: The timber curb on the north side of the deck is in generally good condition but there is some minor impact damage to the east end (**Photo S102**) and some narrow to severe splits and checks were noted. The curb is not anchored at the east end and several anchor bolts are missing nuts. **Sidewalk**: The sidewalk is in generally good condition but several light to severe end splitting and end checks were observed in the timber planks (**Photo S103**). Some screw heads are protruding from the planks and should be driven down. Several bolts securing the planks are missing nuts on the roadway side, and the short curb section at the west end is not anchored correctly. The sidewalk is only 1.2m wide at leaf truss member locations, which is 0.3m (20%) less than the minimum practical width of 1.5m specified by the Transportation Association of Canada. The west approach concrete sidewalk has 2 medium transverse cracks, and the east approach concrete sidewalk has 1 wide transverse crack.			
Ballast Walls (S)	5	5	C
The ballast walls are in generally good condition, but hairline and narrow isolated vertical and diagonal cracks are typical. In the east ballast wall, 4 wide diagonal and vertical cracks, and 2 holes at the bottom with a combined area of 1500mm^2 were noted (**Photo S104**). An area of map cracking with wet stains and some efflorescence deposits was noted at the south end of the east ballast wall.			
Wingwalls (S)	5	5	C
The southeast wingwall has extensive light honeycombing and a 10mm wide vertical crack extending onto the east approach sidewalk at the east end in the original concrete (**Photo S105**). The southwest wingwall has a very severe spall (2m by 2m) at the base at the east end at the interface with the abutment wall (**Photo S106**). A medium horizontal crack at the east end was also noted in the southwest wingwall. Vegetation growth is occurring below the high-water mark.			
Abutment Bearings / Live Load Supports (S)	4	4	A
The two large pedestal bearings (live load supports) on the east abutment typically exhibit light corrosion on the anchor bolts and on some steel plates. The northwest anchor bolt of the south bearing is bent and has medium to severe corrosion on the lower section (**Photo S107**). The bottom of the north bearing is covered in dirt and debris. The north side of the leaf span is not fully seated on the north bearing with a gap of approximately 2mm noted (**Photo S108**). Under live load the span becomes fully seated. Light corrosion was noted on the bearing plates of the buffer supports.			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
Approach Slabs (S)	3	3	M, A
The concrete approach slabs do not have an asphalt wearing surface. East: The east end of the approach slab and southeast approach sidewalk are lower than the west end, suggesting differential settlement has occurred in the past (Photo S6). Two wide transverse cracks near the center of the slab (Photo S109) are at the same location as wide cracks in the curb, sidewalk and southeast wingwall (Photo S105). The interface between the slab and the adjacent asphalt wearing surface has opened up (especially on the north side) due to spalls in the slab and cracks and potholes in the adjacent asphalt (Photo S110). There is a wide transverse crack at the west end of the slab at the interface with the top of the ballast wall. The slab has widespread abrasion/wear from vehicles causing the painted shared vehicle/bicycle lane symbol in the westbound lane to be worn away. A surveying program was initiated in 2018 to determine if the observed settlement of the east approach slab is ongoing, with 9 survey points established on the approach slab and sidewalk. In comparison with the base data collected during the 2018 CDI, the elevations measured during the 2019 inspection are 0.005m higher, with one point being 0.006m higher than the 2018 elevations. These values are at the threshold of the allowable accuracy based on the methodology and precision of the equipment used. Therefore, there is no evidence of further movements of the east approach. West: The concrete slab has longitudinal wide transverse cracks and widespread abrasion/wear from vehicles. The wide gap (up to 35mm) at the interface with the ballast wall is only partially sealed with the seal in the westbound lane being 100% deteriorated, and the seal in the eastbound lane being partially deteriorated.			
Guide Rails (S)	1	1	A
Northeast: The west end of the guide rail is not (and cannot be) connected to the structure. There is minor impact damage to the east end treatment. There is a slight deformation at the 5th post from the east. The spacing of the guide rail posts adjacent to the connection to the structure does not meet current MTO standards or TAC requirements and the guide rail may not sufficiently re-direct errant vehicles back onto the roadway. Northwest: No significant material defects were noted. There is a minor deformation between the 2nd and 3rd posts from the west. The spacing of the guide rail posts adjacent to the connection to the structure does not meet current MTO standards or TAC requirements and the guide rail may not sufficiently re-direct errant vehicles back onto the roadway, causing the errant vehicle to impact the vertical truss member. Southwest: The timber posts are breakaway type posts which may allow the railing to deflect onto the sidewalk in the event of a vehicle impact, which is a hazard to pedestrians. The 7th and 8th posts from the west end of the southwest guiderail have been damaged by vehicular impact (Photo S111). There is minor damage to the steel channel. The spacing of the guide rail posts adjacent to the connection to the structure does not meet current MTO standards or TAC requirements and the guide rail may not sufficiently re-direct errant vehicles back onto the roadway, causing the errant vehicle to impact the vertical truss member.			
Embankments not Supporting Foundations (S)	6	6	D
The southeast and southwest embankments are in good condition with no significant scour or erosion noted.			
Slope Protection (A)	6	6	D
The southeast and southwest armour stone slope protection is in good condition with no significant defects noted.			
Marine Structures – Fender Walls (A)	5	4	B
Refer to the deterioration drawings in Appendix B for more information. Southeast: Most piles have splitting of at least 500mm and rotting. Several walers have light to severe splits and checks including a severe split in the top east fender at the north end, and severe checking in the bottom west waler near the north end (Photo S112). Areas of section loss and damage to the bottom and top walers. 300mm of rotting at the top and splitting are typical at all pile clusters. Some nuts are missing or are loose in the bottom walers (Photo S112). Some vegetation growth is occurring on top of the walers. A waler between piles 32 and 36			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
has been replaced. Eight piles have been jacketed with fiberglass filled with concrete at the waterline and lower (**Photo S112**). Due to a high water level at the time of the inspection, the lower quarter of the lower waler was submerged (**Photo S112**). **Southwest**: Multiple piles have splits and/or rot. The bottom waler has an area of splitting at the north end. The lower set of steel cables securing the structure to the south dolphin are corroded and loose (**Photo S113**). The fourth and fifth safety line posts from the north end are loose, and the second post from the north end is wooden rather than steel. All pile clusters have little to no structural strength as they all exhibit rotting, splitting, and crushing (**Photo S114**). Piles and top walers are in a newer condition than the bottom walers. Old, unused, rotten piles at the north end to the west of the fender were noted just below the waterline (**Photo S115**). *Condition Rating has been downgraded to reflect material defects and potential performance deficiencies.*			
Signs (A)	Not Rated	Not Rated	U
The *Object Marker* signs at the four quadrants are in good condition with no significant defects noted. The marine navigation sign attached to vertical member 9S-10S is in good condition. The west Low Clearance sign attached to member 13S-13N is in good condition. The east Low Clearance sign was removed from member 1S-1N and put on a timber post at the northeast corner during the inspection (**Photo S117**). Cracked welds were noted on the sign bracket, which could cause the sign to fall (**Photo S116**), which warranted the removal of the sign due to the safety hazard for vehicles. *Element not rated as per BIM p.A10-1.*			
Utilities (A)	Not Rated	Not Rated	D
Some of the submarine cables were replaced in 2012 and were noted to be in good condition during the 2019 underwater inspection. A number of the original cables are still in place, but it is unclear if they are still in service. *Element not rated as per BIM p.A11-1.*			
Catwalks and Stairs (A)	2	2	S, B
There are no safety chains or gates at openings in railings or fall-arrest cables at ladders, which are potential safety hazards. *Condition Rating is based on PCR of cantilevered platform at 21N.* **Catwalks - 17N-17S:** The east c-channel supporting the catwalk is supported by the tapered cantilevered members below but only 25mm of the bottom flange is actually supported (**Photo S118**). The opening on the west side of the catwalk to the south of the mechanical house is a falling hazard. The 3rd railing post from the north end is cracked. **21N-21S:** A severe perforation in the member supporting the cantilevered platform at the north end has reduced the edge distance of bolts in the connection to almost zero. There are perforations in the east and west supports of the south member. The west railing has two open sections (leading to ladders) which are a potential falling hazard (**Photo S119**). The safety cages at the ladders at the ends of the catwalk are too short which is a potential falling hazard. **22N-22S**: The east handrail is bent at the north end (**Photo S120**), and three are two cracked railing welds at the northeast corner. **21-27:** 3 north railing posts have split vertically over half their height (**Photo S121**), and 1 post on the southwest side has split. There is no safety chain or gate at the west end of the catwalk preventing access onto the counterweight roof. **Stairs – 15S-17S:** There is a cracked end post at the southeast corner, and a crack in the end post at the northeast corner at the bend in the top rail. **17N-21N**: There is 3mm deep pitting in the channels and supporting angles at many steps. The north railing has a cracked weld, there is a perforation in the north support at 17N, and the southwest railing post on the platform below 21N is split. **17S-21S**: There is 3mm deep pitting in the channels and supporting angles at many steps, a split post in the north and south railing, and the handrail is bent at several locations. **21-22:** There is a large perforation with an area of 225mm^2 in the north top flange at the 3rd step from the top, and in the south web at the 11th step from the bottom and top step. There is 3mm deep pitting in the channels and supporting angles at many steps and several perforations in the north and south beam at the bottom			

ELEMENT AND OBSERVATIONS	PREVIOUS CONDITION RATING	NEW CONDITION RATING	NEW PRIORITY CODE
step. Perforations in the north and south web at the bottom stair across the entire web coincident with very severe section loss and 3-4mm deep pitting (**Photo S122**).			
Chain Link Fence (A)	6	5	D
No significant defects were noted in the southeast, southwest, or east fences. Some loose barbed wire and some bent and damaged chain links at the south end of the southwest fence were noted. *Condition Rating has been downgraded to reflect new material defects.*			
Lighting (A)	Not Rated	Not Rated	D
The marine navigation lights bolted to vertical members 7S-8S and 7N-8N and the roadway lights welded to leaf truss verticals 3N-4N, 7S-8S, 11N-12N, and 17S-18S appear to be in generally good material condition. A pedestrian light is welded to vertical member 9S-10S and appears to be in good condition. *Element not rated as per BIM p.A11-1.*			

NOTE: P = Primary; S = Secondary; A = Auxiliary

8. Limited Condition Survey of Mechanical Room Concrete Slab

The soffit of the machinery room slab is approximately 6.1 m by 6.4 m and has a total surface area of approximately 39.00 m^2. It is believed that the current slab is the original. The slab exhibits clean medium with cracks (5.0 m), several delaminations (totaling 1.55 m^2), spalls (0.65 m^2), honeycombing (0.65 m^2), and light and medium scaling (16.50 m^2 and 1.46 m^2 respectively). The top of the machinery room slab, with a total surveyed area of 34.30 m^2, is in good condition with only 8.6 m^2 of light scaling noted.

A total of seven 75 mm diameter core ranging in depth from 50 mm to 140 mm were extracted from the mechanical room concrete slab at the following locations:

Table 4: Mechanical Slab Core Locations

CORE NO.	LOCATION
C1	Underside, northwest quadrant
C2	Underside, northeast quadrant
C3	Underside, east, at centerline of slab
C4	Underside, northwest quadrant
C5	Topside, northeast quadrant
C6	Topside, north, near centre of slab
C7	Topside, east, near centreline of slab

Cores C1 and C2 were both full-depth cores, indicating a slab height of 140 mm and 130 mm respectively. This is slightly less than the 150 mm (6”) indicated in the original design drawings for the bridge. Cores C3 and C7 were damaged upon removal. The core hole for C3 was only 50 mm deep and the extracted core was about half that depth. Core C7 had a single full width break near the middle. Visually, the concrete in all cores did not exhibit defects and was in good condition. No reinforcing steel bars were encountered in any of the cores.

Using a cover meter, the concrete cover of the deck was determined to range from 28 mm to 49 mm, with an average of 32 mm. The northwest quadrant has cover ranging between 36 mm and 46 mm, and one point in the southeast quadrant has cover of 49 mm. The original design drawings do not indicate the concrete cover for the slab.

Corrosion potential values from the half-cell tests produced values ranging from -0.110 V to -0.245 V, with an average value of -0.152 V. The half-cell survey indicated that 74.3% of the soffit area likely has no corrosion activity, with a corrosion potential values ranging between -0.000V and -0.199V, and that 25.7% of the deck has a corrosion potential between -0.200V and -0.349V, indicating that corrosion activity is uncertain and low. If potentials over an area are more negative than -0.350V, there is a greater than 90% probability that reinforcing steel corrosion is occurring in that area at the time of measurement, therefore no active corrosion was detected.

Once core sample (C1) was tested for compressive strength, which was found to be 19.5 MPa. Part 1, Section 5.4.1 of the MTO *Structural Rehabilitation Manual* (SRM) indicates that concrete with a compressive strength of less than 20 MPa is of poor quality. The original design drawings do not indicate the compressive strength of the concrete in the slab.

Two cores (C2 and C7) were tested for chloride ion content. The chloride content (by mass of concrete) threshold required to initiate corrosion is 0.025% according to Section 5.4.3 of the SRM. For Core C2, the corrected chloride ion content at the average concrete cover was found to be 0.023%, with a background chloride ion content of 0.006%. This is below the required threshold. However, the corrected chloride ion content of Core C2 in the region of 0 to 10mm from the soffit was found to be at 0.033%, which is above the required threshold. For Core C7, the corrected chloride ion content at the average concrete cover was found to be 0.010%, with a background chloride ion content of 0.006%. The chloride content was below the 0.025% threshold at all depths. The absence of significant levels of chlorides in the concrete slab is not surprising given that the slab is not exposed directly to de-icing slats form the roadway below.

A copy of the laboratory test results along with photographs of the cores are included in Appendix I.

9. Mechanical Inspection and Assessment

9.1 Inspection Findings

The following sections of this report provide a description of the primary mechanical machinery systems, documentation and discussion of the conditions found, and conclusions with appropriate recommendations based on the findings.

Schematic diagrams of the structure, span drive machinery, span support machinery, and span lock machinery are presented in Figure 6 through 9 below. Photographs were taken of mechanical conditions of interest during the inspection and are presented with detailed captions in Appendix D.

9.1.1 SPAN DRIVE MACHINERY

The span drive machinery comprises bearings, brakes, motors, open gearing, operating struts and operating strut guides. A schematic of the span drive machinery with component designations is presented in Figure 7.

9.1.1.1 Bearings

The span drive machinery has eleven bearings excluding the bearings in the differential and the operating strut supports. The B1 bearings are located outside of the machinery house to support the pinion shafts adjacent to the operating strut supports. The remaining span drive bearings are inside the machinery room. The B1 and B2 bearings have bronze bushings. The remaining bearings are babbitt lined bearings. All of the bearings are secured in split pillow block housings and are grease lubricated.

The bearings are generally in fair condition. The bearings appear to be adequately maintained and were adequately lubricated at the time of the inspection. Noted issues include poor bearing alignment and minor paint deterioration and corrosion on two bearings.

It was previously noted that the clearance measurements and taper in the clearance measurements demonstrate poor alignment at four of the bearings including: B3-S, both B4 bearings, and B5-N-OB. This alignment was visually verified during the inspection to evaluate the condition of the shaft alignment to the bearings. Generally speaking, the misalignment at the bearings will accelerate wear. Given that only light wear had been measured based on the 2011 and 2016 SBE inspections, adjustments to correct misalignment are not recommended at this time.

At the B1 bearings there was minor paint deterioration and corrosion between the bearing cap and base at the upper split line (Photo M1). This area is difficult to access; however, consideration should be given to removing the corrosion to prevent future deterioration. Note that care must be taken to protect the wearing elements of the bearing during any maintenance work to remove the corrosion.

The bearings associated with the differential assembly were visually inspected to the extent possible. The nature of the assembly limits inspection to some degree. Externally the bearings were in good condition with adequate paint coverage and satisfactory lubrication. No exceptions were noted at these bearings based on a visual external inspection.

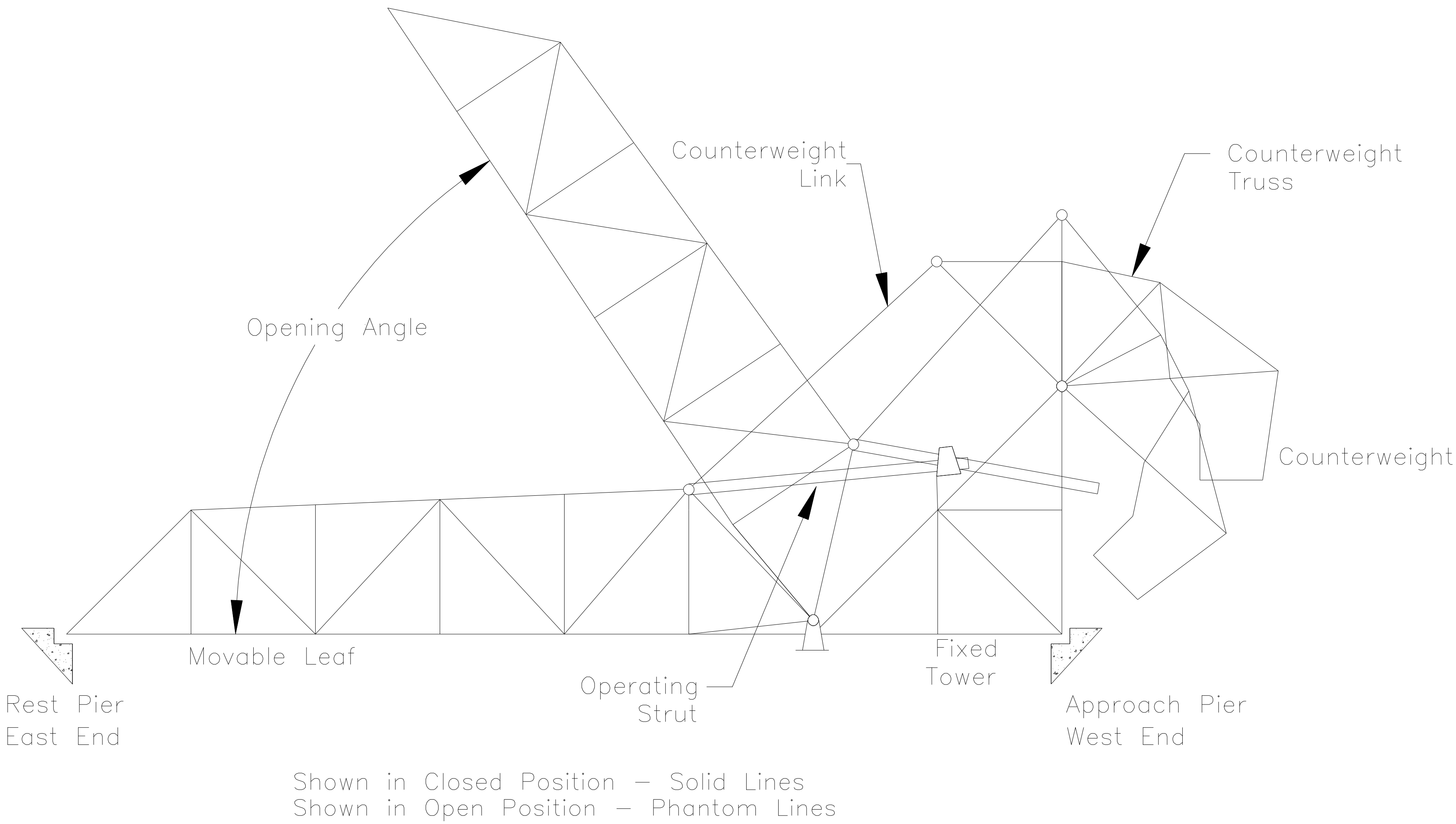


Figure 6: Schematic of Bascule Bridge

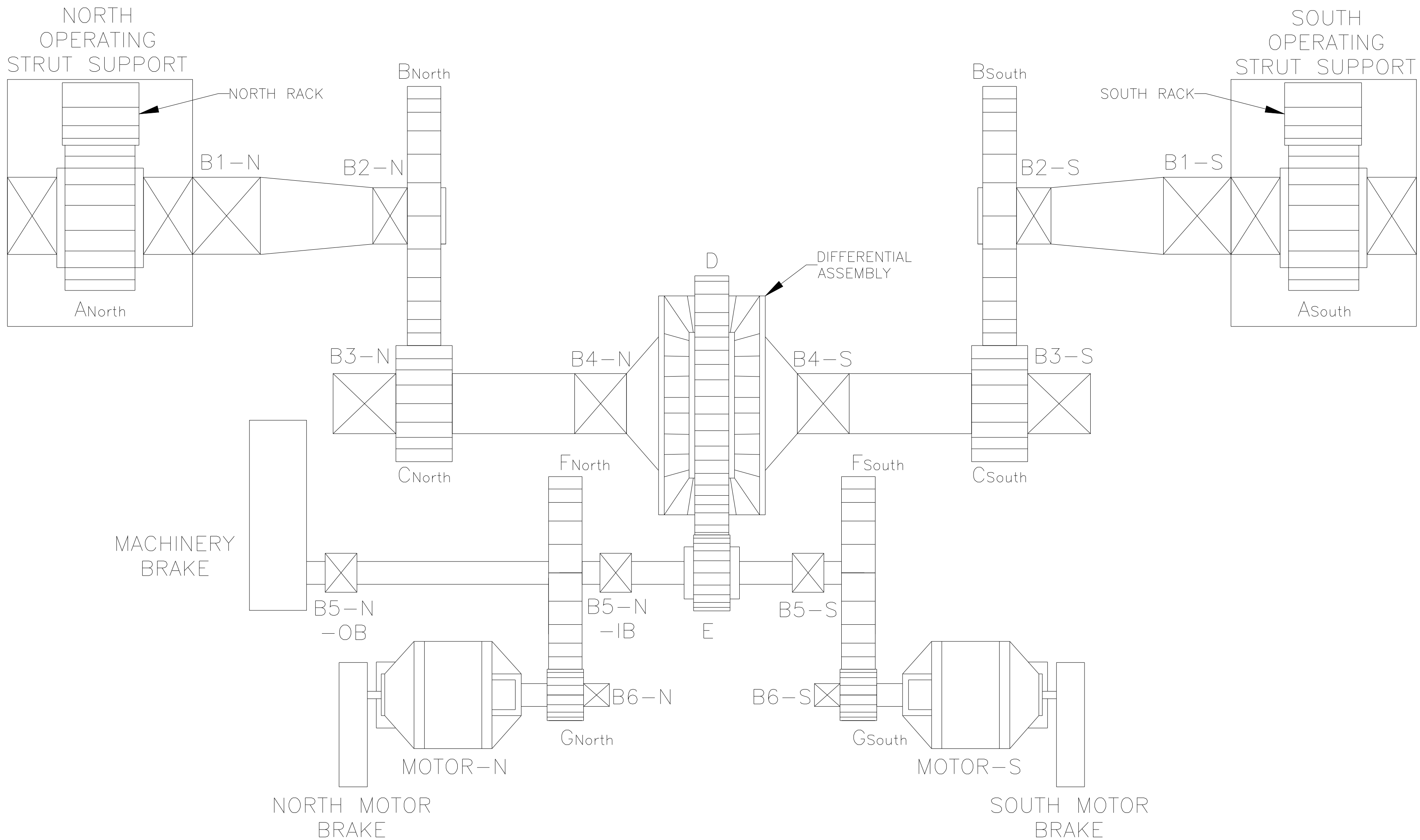


Figure 7: Span Drive Machinery

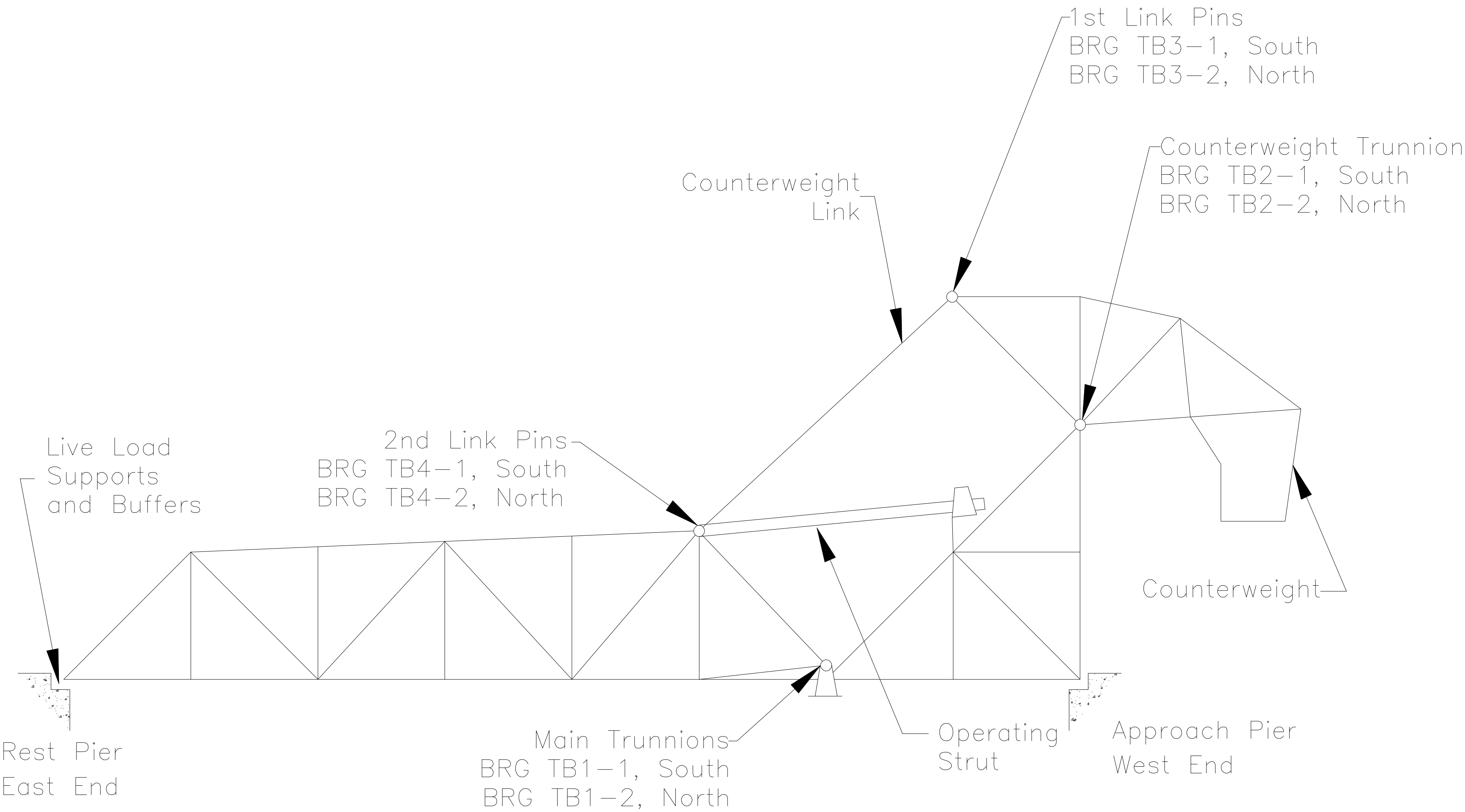


Figure 8: Span Support Machinery

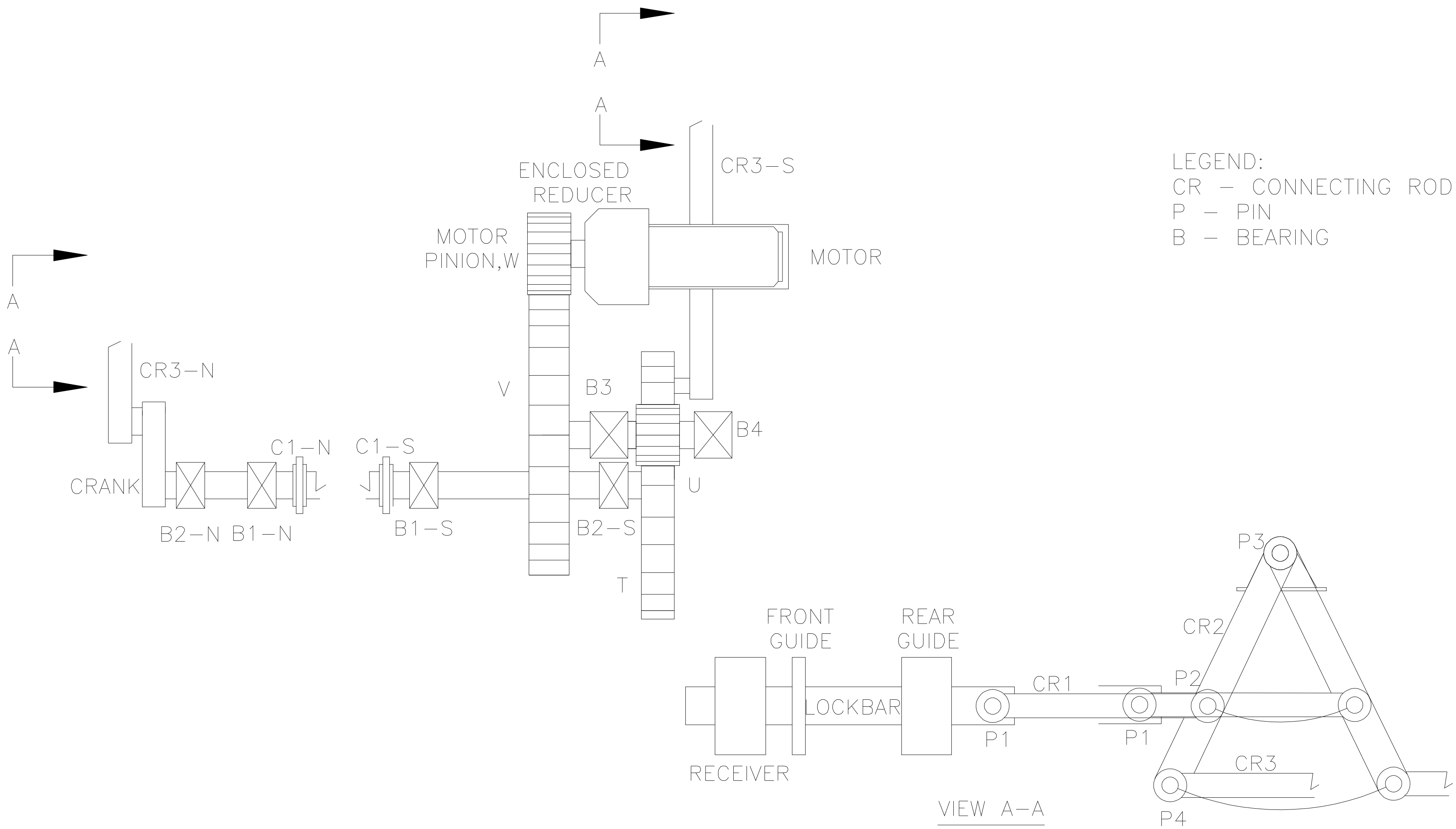


Figure 9: Span Lock Machinery

9.1.1.2 Brakes

The span drive machinery is equipped with three brakes. One motor brake is mounted on each motor shaft extension on its non-driven end. One machinery brake is mounted outboard of bearing B5-N-OB (see Figure 7). All brakes are thrustor released, spring set, shoe type brakes.

Proper installation and maintenance are important to ensure that the brakes provide torque per the design. Factors that commonly affect brake torque are improper brake torque settings, inadequate thrustor gaps, poor contact at the brake shoes, corrosion on the wheel friction surfaces, and contamination of the friction surface from grease or oil.

Based on the provided brake assembly torque scales, the brake settings are:

- South Motor Brake – 1.07 kN-m (790 lb-ft)
- North Motor Brake – 1.09 kN-m (800 lb-ft)
- Machinery Brake – 1.63 kN-m (1200 lb-ft)

The contact between the brake shoes and the brake wheels was checked using feeler gages and compared to the manufacturer's (Magnetek) recommendation of a minimum of 60% contact. (This is required to decrease the contact pressures and ensure that the provided torque is sufficiently applied to the friction surface.) Based on this check, all of the brakes satisfy the manufacturer's recommendation.

The thrustor oil level at all brakes was inspected. The oil levels were within an acceptable range at the time of the inspection.

The northeast mounting bolt nut on the machinery brake was noted to have poor bearing, this is a previously noted condition that has been monitored by SBE since 2011. No movement was noted during the inspection. The machinery brake mounting bolts and surrounding areas have light corrosion (Photo M2).

At the time of the inspection, the brakes operated properly and reliably.

9.1.1.3 Motors

There are two motors associated with the span drive. The motors were recently replaced in 2018 and are generally in like-new condition. The motor mounting supports are sound, and no movement was noted during operation. It was noted however, that the underside of the motor mounting plates is unpainted. There is currently no corrosion on the underside of the mounting plates, but they should be painted to prevent future deterioration (Photo M3).

9.1.1.4 Open Gearing

The span drive machinery is provided with seven open spur gear sets excluding the bevel gears and pinions associated with the differential assembly. See Figure 7.

Due to the nature of the rack pinion and operating strut guide assembly, many of the machinery interfaces cannot be inspected externally. As part of this inspection the assemblies were visually inspected with limited access with the bridge in the closed position. The assemblies were also observed during opening and closing operations of the span to check for unusual behavior that would indicate a problem. Unusual movement was not noted at the north and south assembly. The north operating strut guide assembly was recently rehabilitated in early 2018. In November 2015, the south operating strut guide assembly was disassembled, and the components were inspected by SBE. The findings are summarized in a January 2016 report. This inspection found deformation at the keys and keyways (2.0 to 2.3 mm clearance) and a poor fit between the pinion shaft and pinion (0.25 mm clearance) but the conditions were not as severe as the north pinion prior to the 2018 rehabilitation. A failure at this connection would result in a catastrophic loss of control of the structure. The fits between the south guide assembly components should be restored in the near term. Until such time that repairs are implemented to restore the fits, periodic inspection of the internal conditions is warranted. An in-depth inspection of the south operating strut guide assembly should be performed on a 5-year basis with the next inspection occurring around November 2020.

The span drive spur gears were cleaned and visually inspected for wear and contact. Based on the visual inspection all gears show minimal to light wear with the exception of the north and south racks and pinions which have moderate wear.

Generally, all the gear teeth are in fair condition with light plastic flow and light abrasive wear but with the following exceptions:

- The wear patterns at both B and C gear sets indicate mostly full-face contact with evidence of minor end loading.
- The wear patterns indicate slight end loading on the south side of gear set D and E. There is minor damage on the south side of the opening and closing faces of many of the pinion and gear teeth. Moderate damage was noted on the south side of the closing face of gear D at one location (Photo M4). Similar damage was noted on the opening face on pinion E (Photo M5).
- Based on the contact pattern in the lubricant there is full face contact noted at the north and south F and G gear sets. The contact wear pattern at the north G pinion indicates light cross bearing with heavier contact on the north side of the opening face and heavier contact on the south side of the closing face (Photo M6). This condition is expected to wear in as the G pinions were installed in 2018 as part of the motor and drive rehabilitation.
- The north and south rack and pinions have moderate wear but are in fair condition overall. At both gear sets there is minor metal flow and areas of minor damage to the teeth; many of these locations may be from original casting defects but some appear to be abrasive wear (Photo M7). Based on the wear pattern in the lubrication, the contact between the racks and pinions varies substantially, from 30% of the face up to full contact.

The damage noted at the D and E gearset is likely due to high contact stress. This is likely attributable to the poor alignment noted at this gearset. Previously noted high impact loading to the machinery during the braking operation (prior to the 2012 brake replacement) may also have been a factor. Based on a comparison of the current conditions with those photographs from the 2011 and 2018 inspections, it does not appear that the condition is worsening.

The gears associated with the differential assembly were visually inspected to the extent possible. The nature of the assembly limits inspection. There were no noted issues with the gearing, lubrication, mounting or fasteners at the time of the inspection.

9.1.1.5 Span Operation

The bridge was operated several times during the inspection. The machinery operated reliably and smoothly during all operations.

9.1.1.6 Auxiliary Span Drive Machinery

The 2018 motor and drive rehabilitation included modifications to the system to operate the span under power from the standby generator in the event of a utility power failure. The inspection included operation of the span with the generator providing power to the motors. No issues were noted.

9.1.1.7 Operating Strut Guides

The operating strut guides are designed to keep the racks and rack pinions at the correct center distance. Each operating strut guide is equipped with two pairs of lower guide wheels and one pair of upper guide wheels. The lower guide wheels support the dead weight of the rack and operating strut when unloaded. The upper guide wheels limit separation between the rack and rack pinion during span operation due to the separating force. Loading should be equally distributed among all wheels at a given location.

Due to the nature of the operating strut guide assembly, many of the machinery interfaces cannot be inspected externally (Photo M8). The north operating strut guide wheel bushings were replaced as part of the 2018 north guide assembly repair.

The south operating strut guide assembly was disassembled in November 2015 by SBE and the components were inspected as summarized in a January 2016 report. The most significant finding of this inspection was loose fits at the pinion and shaft assembly, however the guide rollers were also found to have significant bushing wear. The clearances measured at the bushings for the inboard and outboard lower east rollers warrants replacement of the bushings.

As part of this inspection the assemblies were visually inspected in the closed position. The assemblies were also watched during operations of the span to check for unusual behavior. Externally, the operating strut guides are in fair condition and there were no issues noted during operation.

9.1.1.8 Operating Strut

The front end of the operating strut is pin connected to the top chord of the main truss on the bascule span at the outboard side of the second link pin (see Figure 8). The bearings for the pin connection of each operating strut appear to be receiving regular lubrication and all lubrication fittings were present.

The bearings at the pin connection are difficult to access for inspection. In 2016 clearance measurements were taken at the inboard bearings and the maximum clearances were noted for being outside of the limit used normally to recommend rehabilitation. The clearance at the north operating strut bearing was 0.89 mm (0.035 in) and the clearance at the south operating strut bearing was 1.14 mm (0.045 in). Because the large clearances at these bearings do not adversely affect operation of the bridge, rehabilitated is not recommended at this time.

Both the inboard and outboard bearings for the south operating strut move relative to the structure demonstrated by cracked paint and fretting corrosion between the bearing housings and the structure and at the rivets that secure the housings to the structure. This condition was noted in previous inspections and it is apparent that fretting is actively occurring (Photo M9). The south inboard bearing rivets were replaced with turned bolts during the winter 2019/2020 repairs project. At the inboard bearing at the north side of the bridge the rivets used to secure the bearing to the structure have been replaced with turned bolts. Fretting is actively occurring between the bearing housing and the structure, indicating relative movement at this interface (Photo M10). At the north outboard bearing no evidence of significant movement was observed. This condition is minor and should be monitored in future inspections.

The rollers that support the operating struts when the bridge is in the full design opening angle of 84° are not used due to the current limited opening angle of about 65°. Given the poor access and given that they are not in use, it is unlikely that the bearings for the rollers are being maintained. Rehabilitation of these assemblies may be required if the strut supports are intended to be returned to service.

9.1.2 SPAN AND COUNTERWEIGHT SUPPORT SYSTEMS

The span and counterweight support systems comprise two main trunnion bearings, two counterweight trunnion bearings, two first link pin bearings (counterweight side of counterweight links), and two second link pin bearings (span side of counterweight links). Figure 8 identifies the primary span support components.

During the course of the inspection, each of the bearings was observed during operation. No unusual movements or noises were detected at any of the counterweight trunnion or link pin bearing assemblies.

The review of these components was limited to an external visual inspection. This inspection did not include disassembly of the bearings to evaluate the internal wearing components.

9.1.2.1 Main Trunnion Bearings

The movable leaf rotates about the main trunnion bearings. The main trunnion bearings (TB1-1 and TB1-2) are situated between structural members that comprise the bottom chord of the bascule truss heel at roadway level. The main trunnions are mounted in the bottom chord (see Figure 8). Access for inspection is limited.

There is contact between the moving structure and the fixed structure in the vicinity of the main trunnion bearings during operation of the bridge. The contact is creating a wear step in the tower leg and wearing away the heads of the rivets in the area (Photo M11). Further investigation should be conducted to determine the integrity of the worn tower leg and rivets. In addition to the contact near the main trunnion bearings, the outboard sides of the bridge structure contact the trunnion support steel at the west abutment. While the contact at the north side is light and appears to be addressed by the applied lubrication, the contact at the south side is heavy and has worn away the paint; the exposed steel is corroded (Photo M12). If the contact is a result of contraction of the bridge with temperature changes then there is no practical corrective action.

During past inspections, standing water was found in the structural cavities that cover the head ends of the lower two mounting bolts at both locations. No water was noted during the current inspection. The head ends of four of the mounting bolts for the main trunnion bearing have 100% section loss due to corrosion at both the north and south bearings (Photo M13). In addition, at the north trunnion bearing there is minor fretting corrosion, indicating movement at the connection interface.

Lubrication of the main trunnion bearings appeared to be recent and adequate. There are three lubrication fittings on the roadway side of each bearing and there is one lubrication fitting on the outboard side of each bearing. All of these fittings are receiving lubrication. In addition, there are three small pipe plugs and one large pipe plug on the roadway side of the bearing. These pipe plugs are typically provided so that the bearings can be periodically purged of old lubricant.

9.1.2.2 Counterweight Trunnion Bearings

The counterweight trunnion bearings are located above and to the west of the span drive machinery room. Access for regular maintenance purposes and external inspection is limited. The construction of the bearing prevents access for clearance measurements.

Each counterweight trunnion bearing includes a trunnion and a sleeve that surrounds the trunnion. The trunnion fits with mating holes in structural steel plates and the sleeve fits around the trunnion and between the structural steel plates. The sleeve is secured to the structure by six studs that pass through the structure and the sleeve. The trunnion and the sleeve rotate with the structure as it moves, and the outside of the sleeve is the bearing journal that slides on the bronze bearing bushing.

The caps for the counterweight trunnion bearings were removed for internal inspection of these bearings as part of the secondary mechanical inspection in November 2015. The only issue noted was water in the lubricant.

The caps were not removed during this inspection however the lubrication seemed recent and adequate with exceptions as noted below.

In past inspections, the sleeve studs, which are used to secure the counterweight trunnion bearing sleeves to the structure, were not tight at some locations and there was evidence that some of the studs may have failed. During the 2019/2020 winter closure the sleeve studs were tested via ultrasonic testing (UT) as part of a mechanical repairs contract. The UT inspection identified three studs at each counterweight trunnion with indications. All of the studs with indications were replaced as part of project.

The original design provided for three lubrication fittings at the inboard and outboard side of each bearing to serve opposite ends of three grease grooves and two lubrication fittings at the top of each bearing. Multiple damaged or missing lubrication fittings were noted during the inspection. New lubrication lines and fittings were installed during the winter 2019/2020 repairs project. In addition, all of the lubrication ports were purged to ensure lubricant is passing through all of the grease grooves.

9.1.2.3 First Link Pins

The first link pins are used to connect the counterweight frame to the counterweight links. Both the north (TB3-2) and the south (TB3-1) bearing assemblies are inaccessible for hands on inspection as they are surrounded by structural steel. The ends of the pins and the nuts that secure the pins are accessible from the walkway that provides access for lubrication. The only accessible portions of the assemblies are the nuts which secure the link pin.

Externally the first link pins appear to be in good condition. There is a single lubrication fitting at the inboard end of each link pin. Lubrication appeared to be recent. The visible portions of the bearing appear in good condition. There is cracked paint between the inboard and outboard nuts and the structure at both link pins, which may be an indication of slight movement (Photo M14). No corrective action is warranted at this time.

9.1.2.4 Second Link Pins

The second link pins connect the lower end of the counterweight links to the movable span. The bushing and housing are bolted to the lower end of the counterweight link and the trunnion and sleeve assembly are secured between two plates which are part of the upper chord of the truss. In addition to the nuts mounted on both ends of the pin, four retaining bolts are used to secure the bearing between the structural steel plates. The retaining bolts pass through to the structural plates and through a sleeve which surrounds the pin. The outer diameter of the sleeve is the bearing journal.

There are three lubrication fittings present at both the inboard and outboard side of the link pins. During the winter 2019/2020 repairs project, new lubrication lines were installed to ensure piping to each individual grease groove. In addition, all of the lubrication ports were purged to ensure lubricant is passing through all of the grease grooves.

The integrity of the second link pins appears good with some light paint cracking and fretting at the outboard and inboard hubs (Photo M15).

9.1.3 SPAN LOCKS

Span locks are provided as a safety device. See Figure 9. The span lock machinery is mounted to the toe (east) end of the bascule span underneath the roadway, which drives lock bars into receiving sockets mounted to the live load support strike plates. The span locks prevent uplift of the span when engaged with the receivers with the bridge seated. The span lock machinery consists of a gearmotor, spur gears, cranks, links, lock bars, guides, and receivers. The gearmotor is located at the south truss. The gearmotor outputs to a pair of open spur gears.

The second gearset output gear has an eccentric pin which serves as the crank for the south lock bar. A floating shaft assembly connects the south “crank” shaft to the north crankshaft, such that both lock bars are driven together. At each side, there is a connecting rod pinned to the crank which is connected at the other end to a lever arm. The other end of the lever arm is supported in a pivot bearing; a clevis rod assembly connects the lock bar to the lever arm part way between the connecting rod and pivot. As the motor rotates, the crank rotates and the connecting rod swings the operating lever in the pivot bearing, which pushes/pulls the lock bar through the guides and in/out of engagement with the receivers. Each lock bar is supported in a front and rear guide; the guides support the weight and operating loads of the lock bar and maintain the alignment of the lock bar.

The span lock machinery was rehabilitated in 2017 and is generally in fair condition with the exceptions noted below.

9.1.3.1 Span Lock Drive

The span lock drive mechanism is functional and generally in fair condition. There were no issues noted at the time of the inspection with the exception of numerous spots of surface corrosion on various mounting bolts, supports, shafts, gears, pins, and crank arms where paint or grease was not fully applied (Photos M16 through M24). These items included:

- The gearmotor mounting bolts, support mounting bolts, and support;
- The “B3” mounting bolts;
- The shaft between “B3” and “B4”;
- The wearing faces of the gear teeth are corroded, though the gears were adequately lubricated at the time of the inspection;
- The cross shaft bearing housings;
- The north and south adjustable arms for position indication;
- The north and south limit switch crank arm mounting bolts to the lock bar;
- The north and south rotary cam limit switch covers.

9.1.3.2 Span Lock Receivers

The span lock receivers were in fair condition with exception to the mounting screws. The south receiver west mounting screws threads are stripped and have pulled out from the support and the receiver is tilted towards the approach (Photos M25 and M26). The cause of the issue is unclear. It may be the result of insufficient thread engagement or attempts to drive the lock with the span not fully seated.

9.1.4 LIVE LOAD SUPPORTS, CENTERING DEVICES, AND BUFFERS

9.1.4.1 Live Load Supports

The movable leaf is equipped with two live load supports with one provided at each corner at the toe end of the leaf. Each live load support consists of a live load shoe and a live load strike plate mounted to the rest pier at the toe end of the leaf (Photo M25). The live load shoes are located under the toe end of the lower chords of the main trusses and include a cut-out through which the span lock receiver fits. It was noted during the inspection that the north live load support bounced under live load from traffic.

The north and south live load supports were in fair condition and provided marginal bearing. Shimming of the live load supports to provide full bearing at both live load supports is recommended. The only other noted issue was corrosion on forming at the underside of the strike plate and the top of the supports (Photo M27).

9.1.4.2 Centering Devices

There is a tapered centering guide integral to the live load strike plate at both the north and south sides of the toe end of the bridge. The centering guides were in good condition with no contact noted at either guide. At the time of the inspection the gaps at the north and south centering devices were approximately 6.35 mm (1/4 in).

9.1.4.3 Buffers

There are two hydraulic buffers provided at the toe end of the bridge that were installed in 2016. The buffers are mounted on the movable leaf, and the strike plates are mounted to the pier.

Both of the buffers were in fair external condition with the following exceptions. The buffer housings were lightly corroded, the buffer mounting bolts were unpainted and moderately corroded, and the interfaces at the connection of the buffers to the span were lightly corroded (Photo M28).

Before the motor and drive rehabilitation in mid-2018, the buffers were necessary to help assist the operator in smoothly seating the span. The new VFD's control the speed and torque of the leaf throughout the operation and effectively control the leaf as it is seated, making the function of the buffers superfluous. Currently, the buffers remain installed on the span and the span drive machinery must drive through their resistance to seat the span. Driving through the resistance of the buffers results in excessive seating torque on the bridge drive system which in turn reduces the design life of the motors, drives and associated machinery.

9.1.4.4 Over-Travel Bumper Blocks

There are provisions for over-travel bumpers to be installed on the operating strut to stop the bridge at the fully open limit of travel. Article 13.6.1.3 of the CHBDC requires that bridge stops be provided. Though there were no stops installed at the time of fall inspection, wooden bumper blocks were installed during the winter 2019/2020 repairs project.

9.1.5 WARNING GATES

The movable leaf is provided with four warning gates, two at each approach. The gates are Chamberlain Liftmaster model BG790-50-53 manufactured by the Chamberlain Group, Inc. The gates are relatively new (identification on the gates indicates a 2013 manufacture) and are in fair condition with no mechanical issues noted. There is spotty corrosion on the gate arms and the housings at all of the warning gates (Photo M29). Additionally, the gate arms are not vertical when raised and they are not horizontal when in the lowered position (Photo M30).

9.1.6 BARRIER GATES

The movable leaf approach is currently not provided with barrier gates. While the bridge is in the fully open position, the counterweight provides a barrier for eastbound traffic. There is no barrier for westbound vehicular traffic. Consideration should be given to installing barrier gates at the east end of the span as noted in Article 13.5.6 of the CHBDC.

10. Electrical Inspection and Assessment

10.1 General Description

The inspection consisted of a visual inspection and testing and taking multiple electrical system chart recordings of the bridge operating system that were sufficient in depth to determine the status of the bridge electrical power and control system and assess the adequacy of the system to perform its intended function.

The inspection work included:

- Information gathering and the review of gathered information in support of the inspection.
- Planning, scheduling of the work with all parties and participation in a worker safety plan including necessary health and safety preparation.
- Inspection of all control and power systems associated with the bridge operating and auxiliary systems. This included a determination of the status and life expectancy of equipment, its installation and its inherent design features that enable the bridge operating system to operate in a safe and reliable manner.
- The inspection was concluded with the submission of this report which documents the findings, provides conclusions and makes recommendations of any actions necessary to meet operating reliability and safety requirements as well as adherence to all prevailing statutory codes.

The electrical inspection and assessments describe all items of equipment defined in the Electrical Inspection Table under the Scope of Inspection section of the report. Items in this report have been arranged in the order of the inspection that begins with the incoming 600V electric utility service for the bridge.

10.2 Main Electrical Service

The status and condition of the bridge main electrical service was found to be the same as was reported in the 2018 electrical inspection report. The main electric utility service comes into the bridge from the northwest approach via an underground utility service feeder. The utility service feeder terminates in the main circuit breaker compartment of the Motor Control Centre (MCC) in the operators control house at the northwest corner of the bridge. The service provided to the bridge is a 600 volt, 3-phase, 3-wire, solidly grounded service. The service is provided with a ground fault indication system that consists of three "Wye" connected lights with its "Star Point" grounded. The ground fault indication lights were all illuminated at the time of the inspection which was an indication that the 3-phase feeder is clear of a phase to ground fault (Photo E6). A utility meter is mounted on the side of the MCC enclosure for metering of the control house and maintenance building auxiliary loads (Photo E1).

To determine the balanced condition of the bridge 3-phase electric utility service, the phase-to-phase and phase-to-ground voltages of the incoming service were measured at the motor control center under no-load condition (only auxiliary loads running) as follows:

Table 5: Phase to phase and phase to ground voltage under no-load conditions

ITEM	DESCRIPTION	VOLTAGE
1	Phase 1-to-Phase 2	612.1 V
2	Phase 2-to-Phase 3	611.1 V
3	Phase 1-to-Phase 3	606.8 V
4	Phase 1-to-Ground	351.5 V
5	Phase 2-to-Ground	353.7 V
6	Phase 3-to-Ground	348.7 V

The measurements of voltage were taken with all bridge auxiliaries operational including an associated maintenance building load. The bridge drive system including traffic gates were switched off during these voltage measurements.

From the above, the no-load phase-to-phase voltages are almost balanced and are within +2% of the mean service voltage of 600 volts.

The phases to ground voltages indicate the voltage being applied to the ground monitoring lights. The minor recorded imbalance indicates that some of the auxiliary loads fed from the lighting transformer are single phase loads and not equally distributed across all three phases, hence causing a slight difference in voltages over the three phases to ground.

No significant physical deficiencies were noted for the bridge utility service at the time of inspection.

In addition to the bridge electric utility service, a 40kW standby generator is installed at the bridge to provide a backup source of power in the event of electric utility failure (Photo E2). This generator was installed in 2015 to comply with the latest version of the Canadian Highway Bridge Design Code (CHBDC). The standby generator was originally not capable of powering the span drive motors to operate the bridge. Part of the goal of replacing the original motors and drive controllers was to be able to operate the bridge using the standby generator. Since the original drives and motors were replaced, the bridge is now capable of being operated using the standby generator. A control system interlock was implemented such that when operating the bridge on generator power, only one motor operation is permitted.

The condition of the generator has not changed since the last inspection, both the generator and its housing are in good operational condition. An emergency stop pushbutton is located on the generator housing to stop the generator in the event of an emergency and this was tested and proved to be operational.

Additionally, the standby generator is provided with a load bank breaker, but no load bank for load testing of the standby generator has been provided (Photo E3).

Generator nameplate data was collected and recorded as follows:

Specification	Standby Generator
Model:	GDX-40-3
Manufacturer:	T&T Power Group
Serial:	TTPG728
kW/kVA:	40/50
Phase:	3
Hz:	60
Volts:	600
Amps:	60
RPM:	1800
Ins. Class:	H
Rating:	Standby

As part of the generator installation, a manual transfer switch (MTS) has been provided and installed in the control house. The MTS is of Eaton manufacture and is in excellent condition (Photo E4).

Corrective action is required as follows:

1. Provide a load bank for the existing standby generator to enable it to be exercised under load without operating the bridge.
2. Infrared thermography testing for electrical equipment at the bridge should be included as part of routine maintenance to ensure safe operation.
3. It is recommended that a protective relaying coordination study and an arc flash study be performed for the bridge electrical distribution system this year.

10.3 Drive System

The new bridge drive system consists of squirrel-cage induction motors with variable speed drives. This new drive system was installed during the most recent rehabilitation to provide desire variable speed and torque control for the bridge. Dynamic braking resistors are also provided for the VFDs for electrical braking and to control bridge overhauling loads. The new drive system was developed to allow both drive motors to be operated simultaneously or individually as duty motors. The drive control system now consists of a 7-position lever type master controller with three (3) speed settings for bridge operation, both for the opening and closing cycle of the bridge (Photo E18). These speed settings are also being controlled by the modified control system to automatically limit the bridge speed based on the position of the bridge. A foot switch is also part of the control system to stop the bridge in the event of an emergency.

The following describes the bridge sequence of operation:

1. Opening sequence:
    a. Switch the traffic signal to 'RED';
    b. Lower the oncoming traffic gates;
    c. Lower the off-going traffic gates;
    d. Pull the span locks;
    e. Release manual brake;
    f. Raise the span;
    g. Bridge stops at the fully open position. (Note: Bridge speed is automatically limited to creep speed at nearly open position. Operator has the option to run the bridge at a slower speed by adjusting the master controller switch between seated position and nearly open position.)
2. Closing sequence:
    a. Lower the span;
    b. At nearly closed span automatically decreased to creep speed. (Note: Operator has the option to run the bridge at a slower speed by adjusting the master controller switch between full open to nearly closed position.);
    c. Bridge fully seated, enable reduce torque mode and start timer to de-energize system;
    d. Motor brakes set, drive(s) de-energizes;
    e. Set manual brake;
    f. Drive the span locks;
    g. Raise the off-going gates;
    h. Raise the oncoming gates;
    i. Turn the traffic signal 'RED' light off and release the traffic.

No corrective action is required.

10.3.1 MOTOR CONTROL CENTRES

The bridge electrical equipment is controlled from a Motor Control Centre located in the operators control house. The Motor Control Centre is comprised of a main incoming circuit breaker, equipment feeder circuit breakers, motor starters, control relays, lighting transformer and a lighting panel. The Motor Control Centre enclosure is NEMA 12 dust tight rated, 600A, 3 phase, 3 wire, 60 Hz and is a 2100 Series MCC as manufactured by Westinghouse Canada and was installed in 1994 (Photo E5). The motor control contactors, thermal overloads and associated instrumentation are all appropriately sized and set for the imposed duty and are in good physical and operational condition for continued service in the long term.

The main incoming circuit breaker appears to be in good condition and adequately rated for the prevailing duty. The motor starter for the span locks is provided with motor contactors, three phase thermal overloads and local indication pilot lights to provide the operator and maintenance personnel with starter status. The new VFDs for the main drive motors are located in their respective freestanding enclosures located adjacent to the MCC (Photo E7). The main feeder breakers for the VFD drives are located in the MCC. The cubicles that contain the VFD feeder breakers also contains drive motor temperature monitors that were used for the original span drive motors and are no longer required. The traffic gate motor starters have been installed in the gate enclosures and not in the MCC. The Motor Control Centre contains feeder circuit breakers for the gates. The MCC is also provided with ground fault indication lights for each phase of the 3-phase power. These indication lights were in an operational condition at the time of the inspection, all were illuminated which is a positive indication that the system is free of a ground fault or ground leakage current (Photo E6).

Corrective action is required to:

1. Remove the drive motor temperature monitoring indicators as they are no longer required with the replacement squirrel cage induction motors.
2. It is recommended that low resistance "Ductor" testing be performed at the bridge at a frequency of every 5-years to confirm the integrity of the contactor and breaker contact resistances.

10.3.2 MAIN MOTORS AND VFD DRIVE CONTROLLERS

The main drive motors have recently been replaced and are of the squirrel-cage induction type. These are two 50 HP drive motors that have been installed in the machinery space for span drive operation. Both main drive motors have identical electrical characteristics and only differ in the shaft arrangement. The bridge drive system is provided with the two (2) drive motors coupled in parallel (Photo E8). The bridge is capable of being operated with a single or both motors. Generally, the bridge is only operated using one drive motor and the operator has been directed to alternate between the two drive motors every day. Both single motor operation and dual motor operation were tested at the time of inspection without any noted deficiencies.

The two drive motors are configured as redundant units. A motor selector switch is provided on the control desk allowing the operator to switch between the two drive motors. The selector switch also includes an option for two motor operation if additional torque is required to operate the bridge. When operating with two motors, one of the drives must be set to follower mode. This can be achieved by switching the key switch in front of the drive cabinet from master to follower. The bridge drive system utilizes a heavy duty 7 position mini-master switch via the originally installed but no longer used, rotor resistor switching contactors to vary the speed of the bridge. With the recently modified control system, the span speed is now limited to creep speed at the nearly open position of the bridge when raising and at nearly closed position of the bridge when lowering to ensure safe operation of the bridge. Dynamic braking resistors are provided for each of the VFD drives to provide electrical braking and to overcome any overhauling condition of the bridge during operation. These resistors were installed as part of the new drive installation and are in new condition (Photo E9).

It was observed during single motor operation, that the operator was forced to switch to two motor operation to properly seat the bridge. If using single motor to seat the bridge, the bridge fails to seat and there is about ¼" gap at the northeast corner of the bridge when it is indicated as being seated. This condition was not observed during commissioning of the bridge.

Disconnect switches are provided in the machinery space to disconnect the motors locally and have been sized and located in accordance with Canadian Electrical Code requirements (Photo E10).

The new VFD drive controllers are located their respective freestanding enclosures adjacent to the MCC in the bridge operators house. Each drive controller enclosure houses a drive circuit breaker, control relays, VFD drive, as well as the indication lights, network jack, reset button, key pad and emergency stop button on the enclosure door. All equipment inside the motor controller compartments are in good operational condition (Photo E7).

Motor nameplate data was collected and recorded as follows:

Specification	Main Span Drive Motor
Type:	Squirrel-Cage Induction rated for Inverter Duty
Manufacturer:	Reuland Electric
SN.:	N18-H0117A-1
Prod. No.:	0500S-VAAN-0004
Frame:	445TZ
Phase:	3
Hz:	60
Volts:	575
Amps:	55.6
Horsepower:	50
Duty:	60min
Speed:	900 RPM

Corrective action is required to:

1. Interrogate the cause of bridge unable to properly seat with single motor operation and provide mechanical or electrical adjustments accordingly.

10.3.3 SPAN BRAKES

The bridge drive system is provided with two (2) main drive motor brakes, and one (1) manual/machinery brake. The original motor brakes were replaced with modern thrustor type brakes as part of the 2012 rehabilitation project. The replacement motor brakes are of Magnetek manufacture and are provided with three limit switches (Photo E11).

- Brake released – permissive with drive controller.
- Brake set – status indication.
- Brake hand released – Interlock to prevent bridge operation with the brake hand released.

The bridge manual/machinery brake is also of the thruster type and is provided with brake set and brake released limit switches only; no brake hand released limit switch has been installed (Photo E13).

None of the brakes are provided with covers for protection and no spare brakes or brake parts are held at the bridge. Local disconnect switches are provided for each individual brake as per code. Wire-nuts have been used inside junction boxes for the motor brake limit switch wiring. The motor brake disconnect switches and starters are both housed in the same enclosure in the machinery space and were installed as part of the 2012 rehabilitation (Photo E14). The wires inside the starter/disconnect enclosure for the motor brakes have not been properly labelled which could lead to errors during maintenance and troubleshooting.

Motor brake actuator nameplate data was collected and was recorded as follows:

Specification	Motor Brake
Manufacturer:	Eldro
S.N.:	12/0557532
Supply:	575/3/60HZ
Amps:	0.92

Machinery brake actuator nameplate data was collected and was recorded as follows:

Specification	Machinery Brake
Manufacturer:	Mondel Engineering
S.N.:	93/39400
Size:	16MBT/E-ED121/6S
Supply:	575/3/60HZ
Amps:	0.96
Torque:	1.898 kN-m (1400 lb-ft)

Corrective action is required to:

1. Provide a hand released limit switch for the machinery brake.
2. Provide protective covers for all brakes.
3. Replace the wire-nuts inside the motor brake limit switch junction boxes with code compliant splices or terminals (Photo E12).
4. Label all wires inside the starter/disconnect switch enclosure for the motor brakes in accordance with as-built drawings.

10.3.4 SPAN LOCKS

The bridge is provided with a span lock motor at the southeast toe end of the bridge (Photo E16). The span lock motor and associated machinery equipment is located under the span on the movable structure. A hand crank shaft is provided at the end of the new span lock motor as a means of manually releasing its brake to enable manual operation of the span lock for maintenance and in the event of a total power failure at the bridge. The hand crank mechanism has not been provided with a limit switch to prevent electrical operation of the locks with the hand crank inserted. A local disconnect switch is provided for the span lock motor but it is inaccessible to maintenance personnel due to its location underneath the span (Photo E16). Two span lock rotary cam switches have been installed, one on each side of the span connected to the corresponding span lock linkage to provide positive indication and control of the span locks. The enclosures for the RCLS's exhibit signs of corrosion (Photo E17).

The span lock starter is located in the MCC and has been modified to operate both the span lock motor and its associated brake. The span lock starter was originally designed for six (6) speed operation using switched motor rotor resistors but the current span lock operation is single speed across-the-line only (Photo E15).

A large span lock operating control switch on the control desk is used to operate the span lock motor. This switch was part of the original installation when the span lock motor was multi-speed. The switch still functions with multiple steps, but its intermediate contacts have been jumpered out. Although the condition of the span lock switch operator is acceptable and is functional, it is recommended that it be replaced with a modern spring return selector switch for single speed operation to decrease the chance of contact failure and possible operator confusion with its non-operational multi-steps.

Corrective action is required to:

1. Provide a hand crank limit switch to prevent electrical operation of the locks with the hand crank inserted.
2. Replace the span lock operator with a new spring return selector switch for proper control.
3. Clean, remove corrosion, and apply protective coating on the span lock RCLS enclosure.

10.3.5 LOAD MEASUREMENT

In an effort to determine the operating characteristic of the main span drive motors their operating load characteristics were measured and recorded under both utility and generator power. The operating parameters (load current, voltage, power, and power factor) were measured during the complete opening and closing operating cycles as shown in Table 5 below. Note all parameters were taken from the output side of the VFD drives.

Table 6: Operating characteristic of the motors.

	PHASE A (AMPS) MAX/AVG	PHASE B (AMPS) MAX/AVG	PHASE C (AMPS) MAX/AVG	PHASE A (VOLTS) AVG	PHASE B (VOLTS) AVG	PHASE C (VOLTS) AVG	REAL POWER (KW) MAX/AVG	POWER FACTOR MAX/AVG	HP/KW RATING
Drive Motor No.1 (utility)	180 / 39	171 / 40	181 / 38	462	464	462	23 / 15.6	0.55 / 0.48	50 / 37
Drive Motor No.2 (utility)	179 / 39	180 / 38	153 / 36	439	437	437	28 / 14	0.58 / 0.43	50 / 37
Drive Motor No.1 (generator)	152 / 41	167 / 41	178 / 39	437	435	435	25 / 14.8	0.60 / 0.46	50 / 37
Drive Motor No.2 (generator)	181 / 32	147 / 33	158 / 34	462	461	461	28 / 15.8	0.59 / 0.47	50 / 37

Note: kW and PF readings are for bridge opening only, these values were very close to zero when lowering the bridge).

The drive motor operating characteristics were recorded using single motor operation over the complete operating cycle of the bridge. From the above results, it can be seen that the average load currents of the main span drive motors are within the nameplate rating of the motors (55.6 Amps). Both motors draw their highest power during the initial opening. This is due to the bridge being span heavy when the highest power draw is required to move the bridge from its stationary closed position. With the new VFD drives operating the bridge we only see a motor load spike during the initial opening and the power quickly stabilizes to a much lower level. This minimizes the impact on the bridge machinery and enables the bridge to be operated on its 40kW standby generator. The average power consumed by the drive motors during raising of the bridge is about 15 kW. This is well below the rated 37 kW of the motor rating. The motor output power peaked at 28kW for a very short duration and is also below the maximum rating of the motor. These results are indications that the new VFD drives and drive motors are properly sized and effectively minimize the power needs to operate the bridge.

During bridge lowering cycle, significantly less power is consumed by the drives, this is also an indication that the bridge is span heavy.

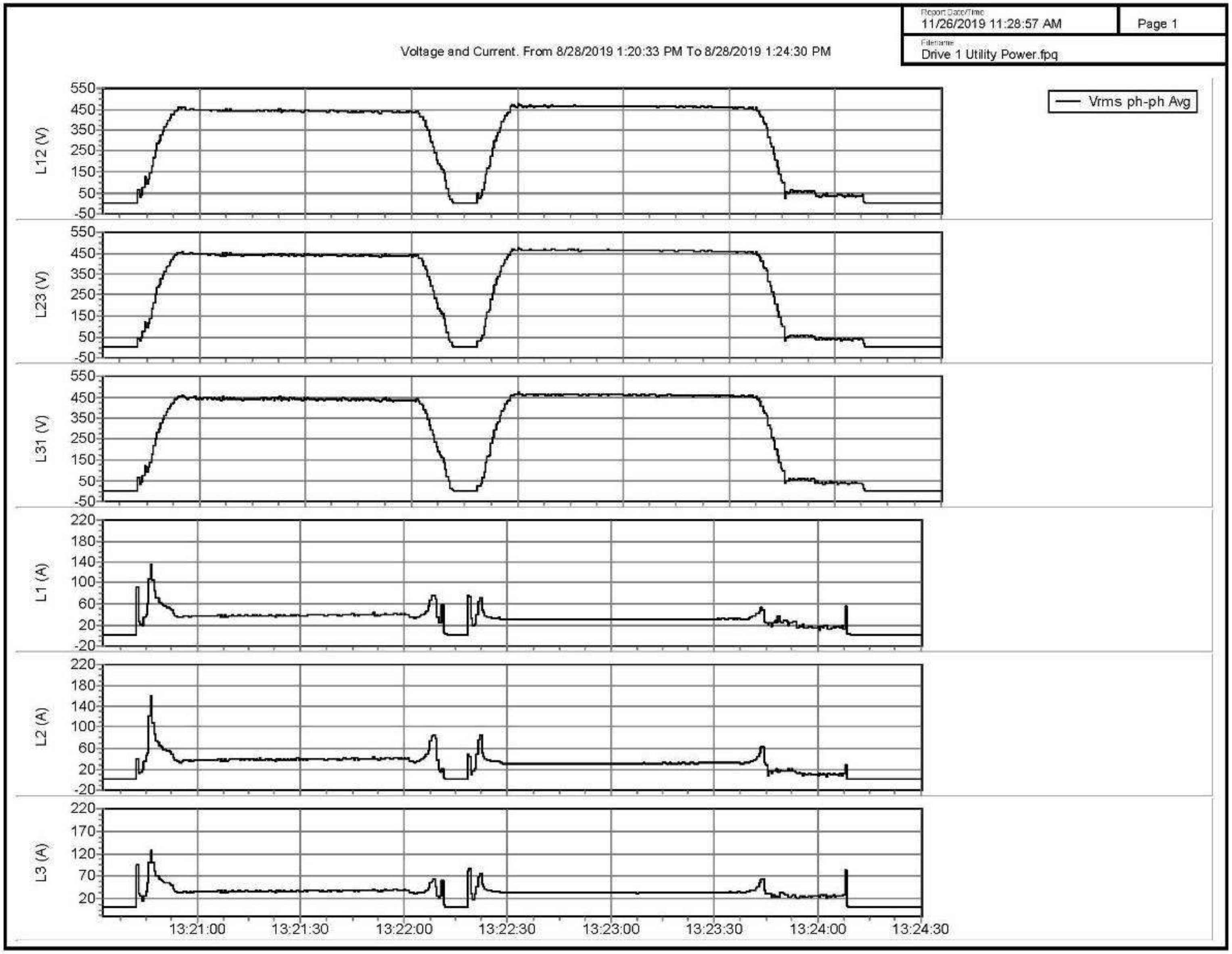


Figure 10: Voltage and Current Parameters (Span Drive Motor 1 Utility Power).

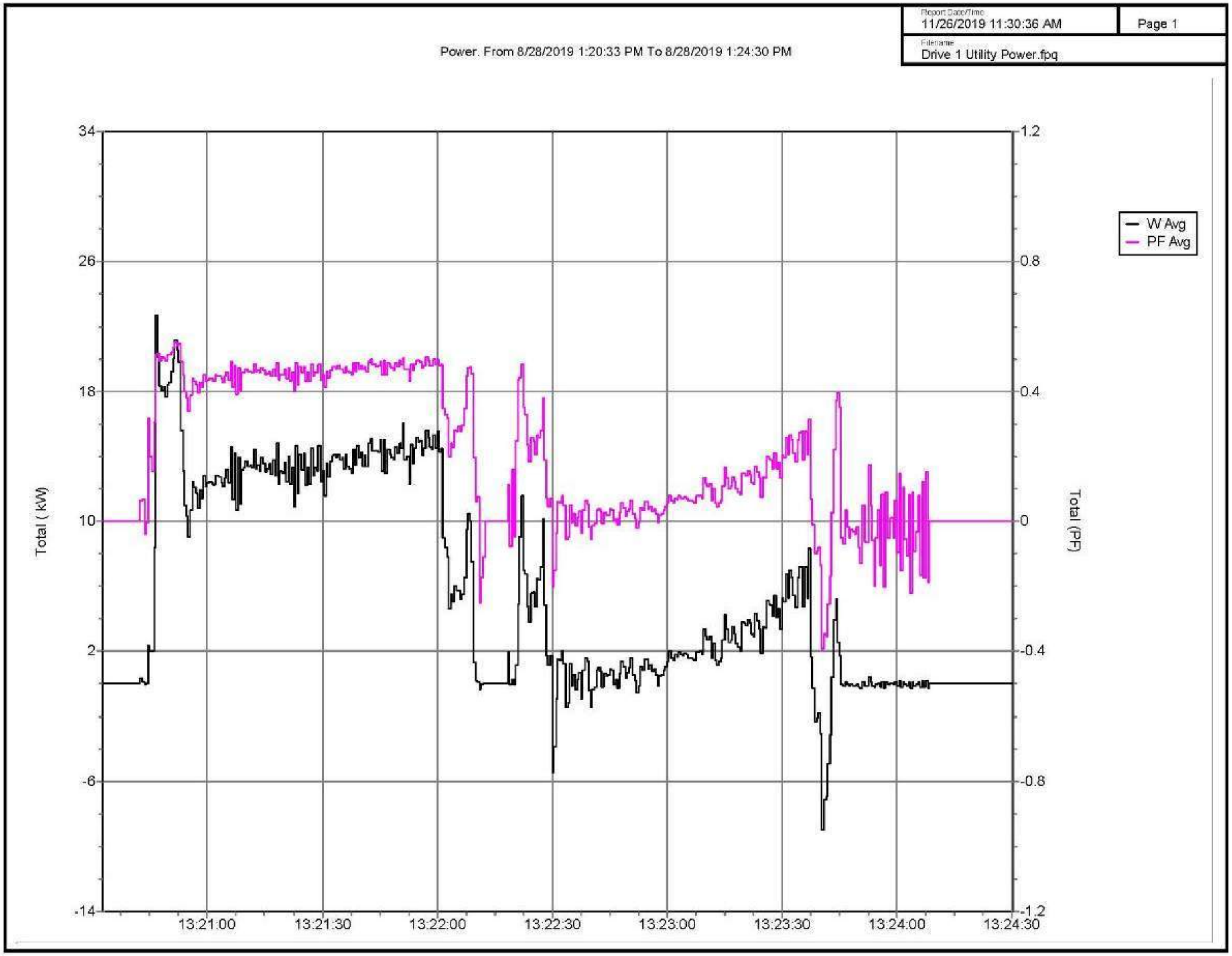


Figure 11: Power Parameters (Span Drive Motor 1 Utility Power).

(Note the motor is drawing more power during raising the span than lowering.)

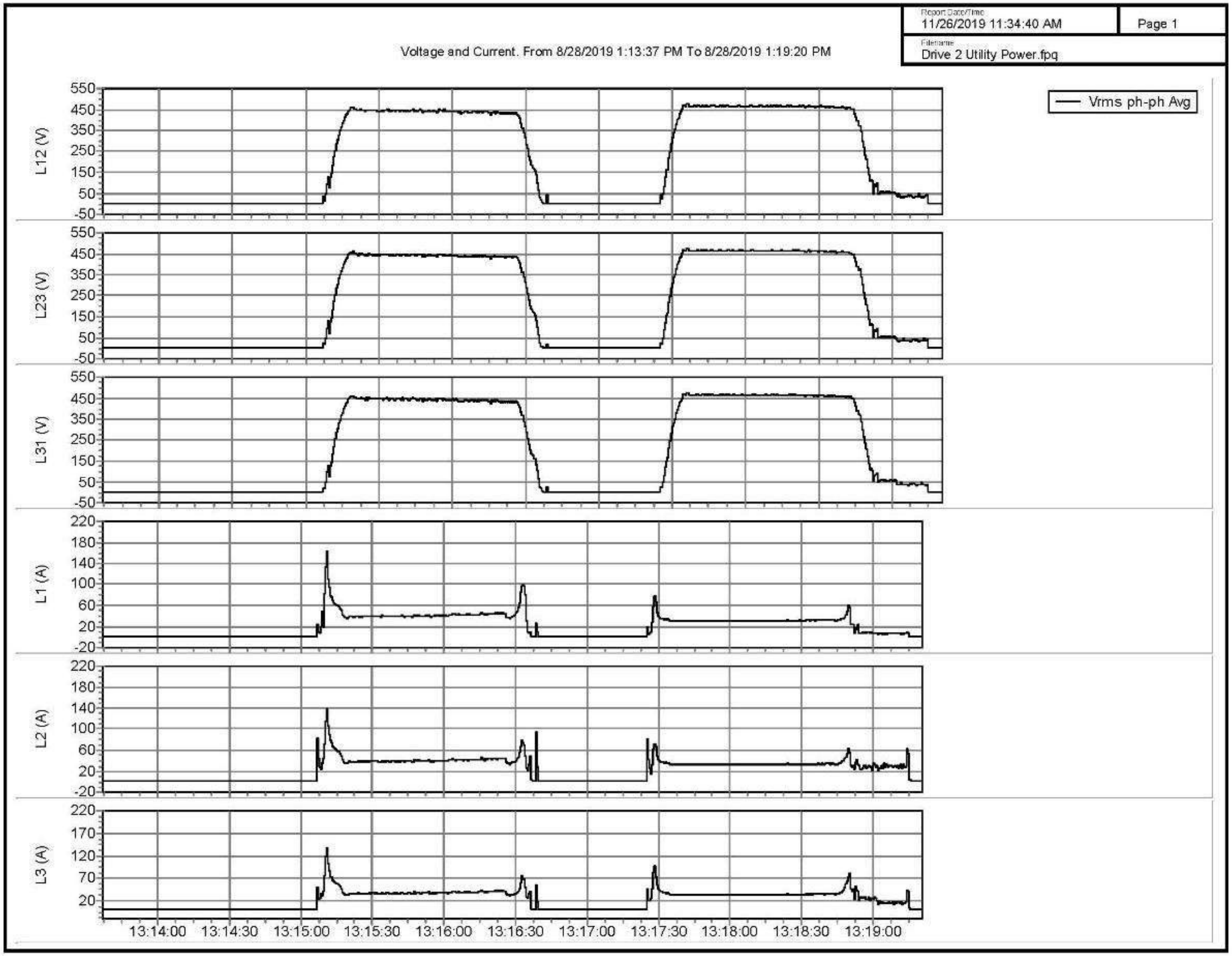


Figure 12: Voltage and Current Parameters (Span Drive Motor 2 Utility Power).

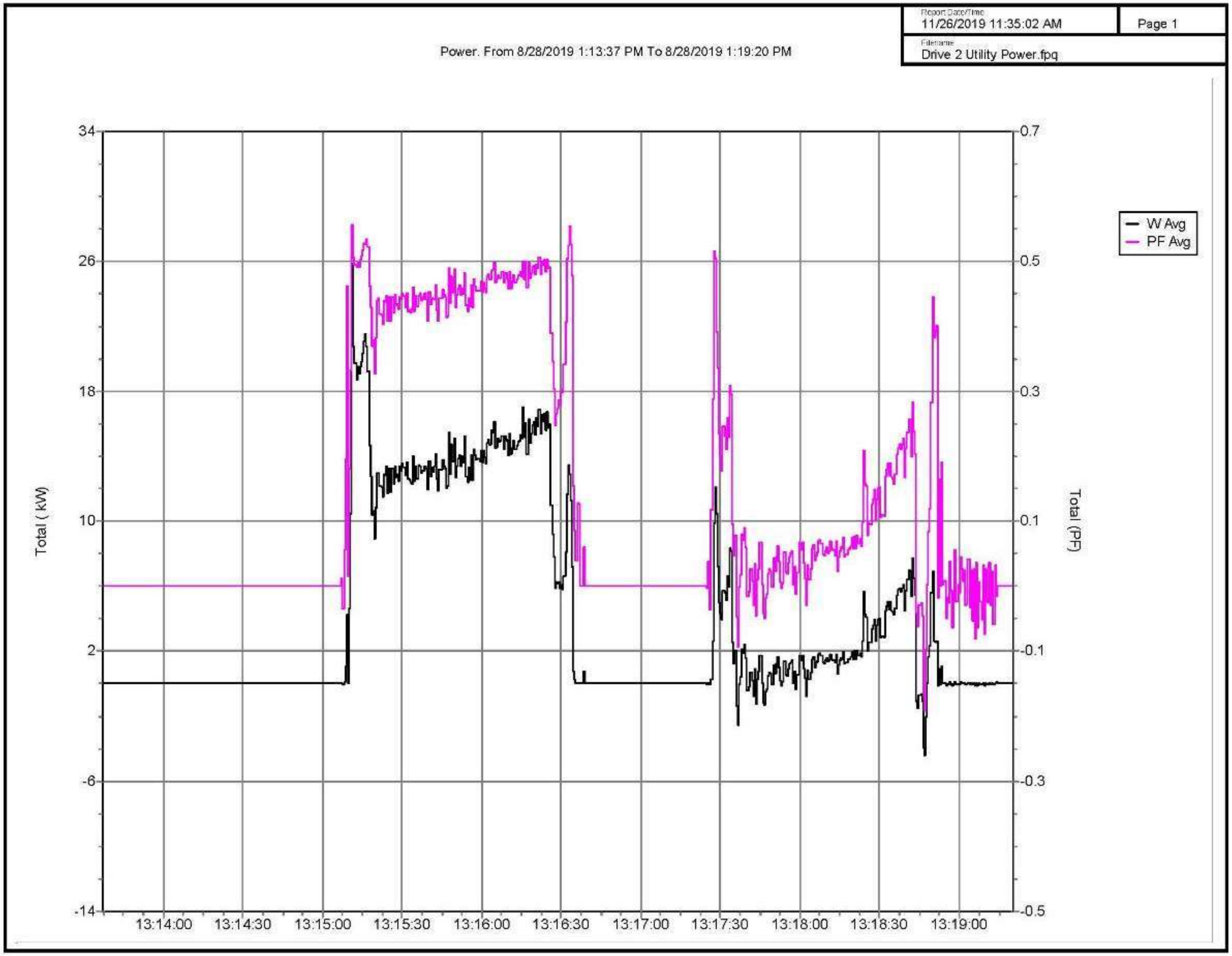


Figure 13: Power Parameters (Span Drive Motor 2 Utility Power).

(Note the motor is drawing more power during raising the span than lowering.)

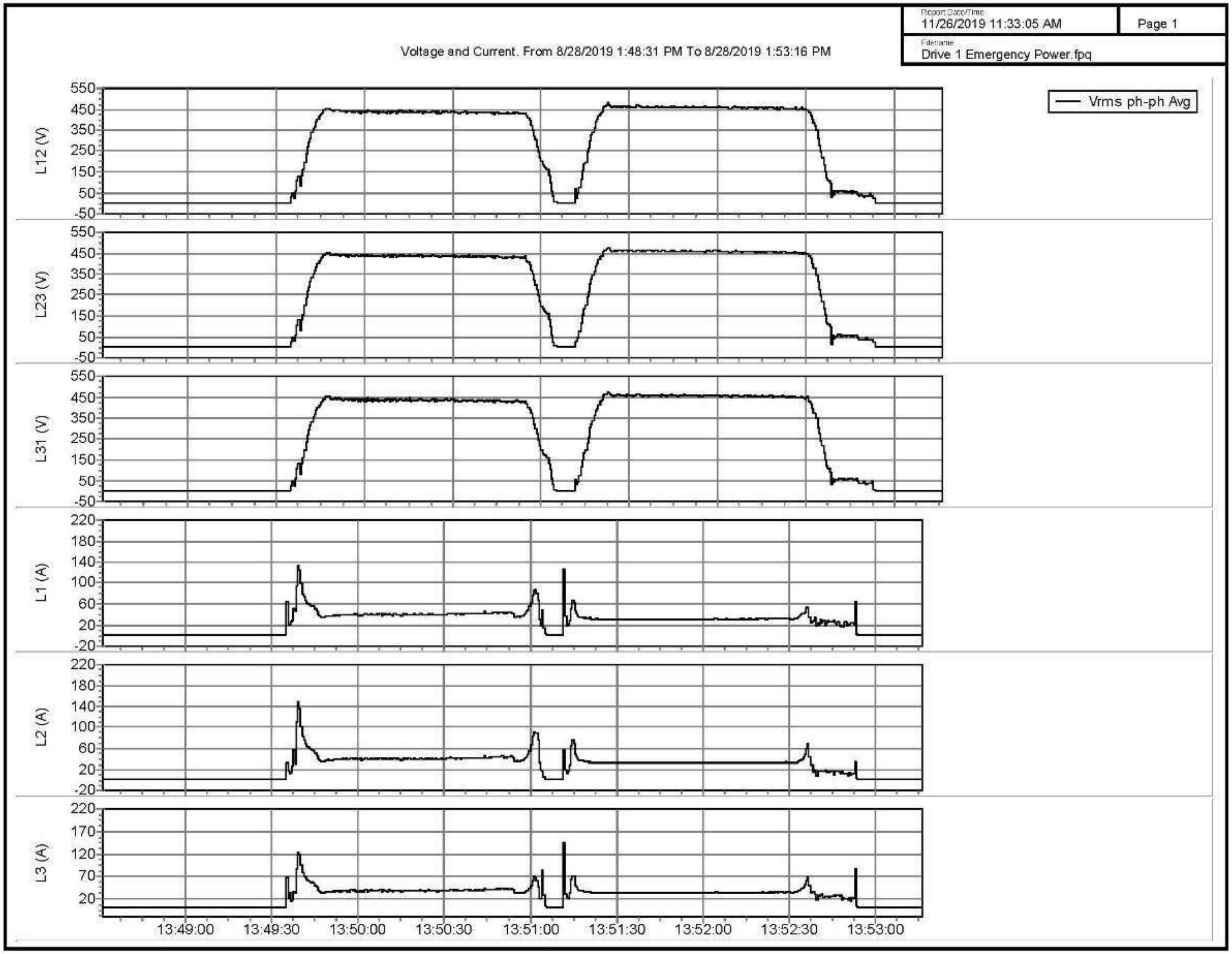


Figure 14: Voltage and Current Parameters (Span Drive Motor 1 Generator Power).

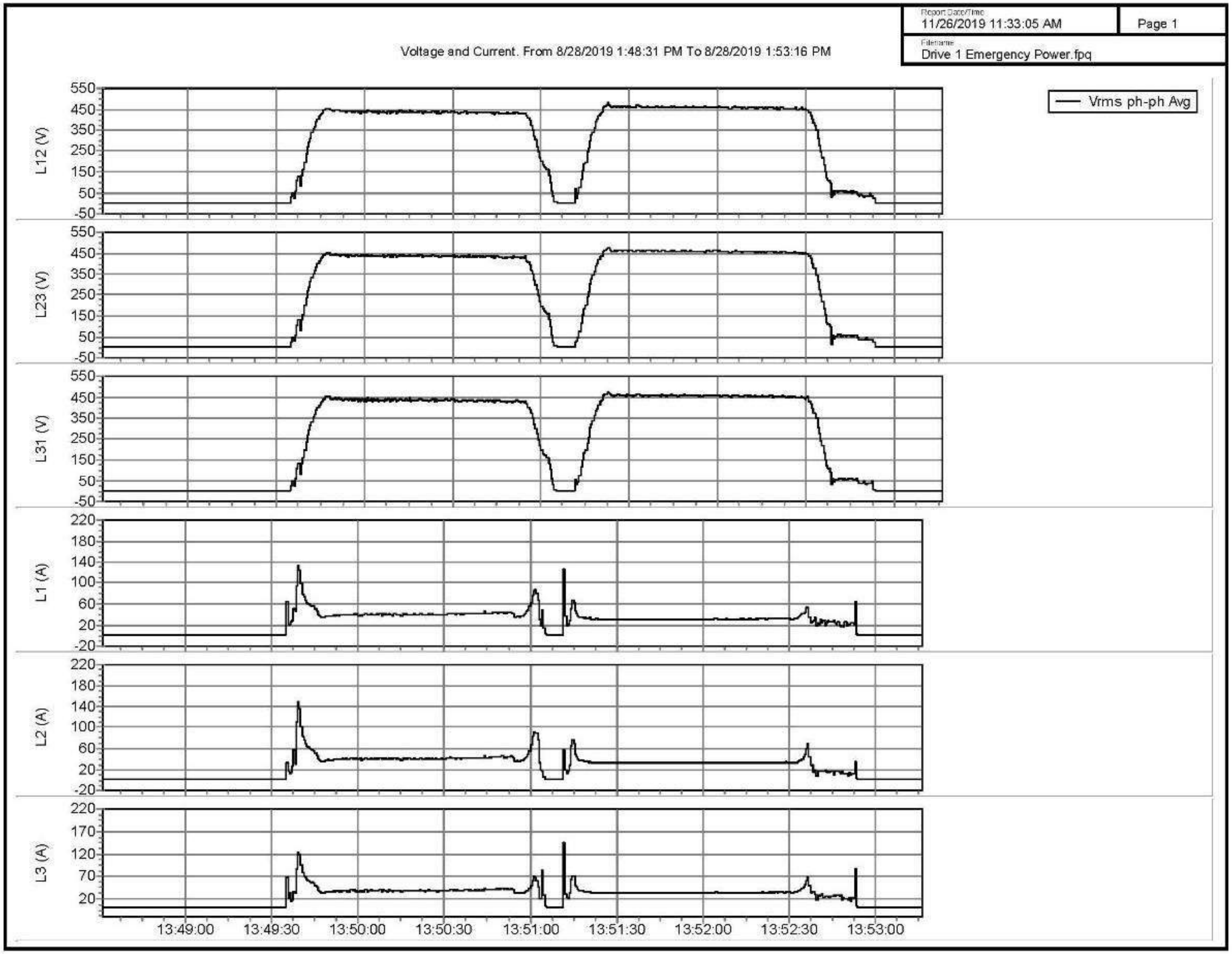


Figure 15: Power Parameters (Span Drive Motor 1 Generator Power).

(Note the motor is drawing more power during raising the span than lowering.)

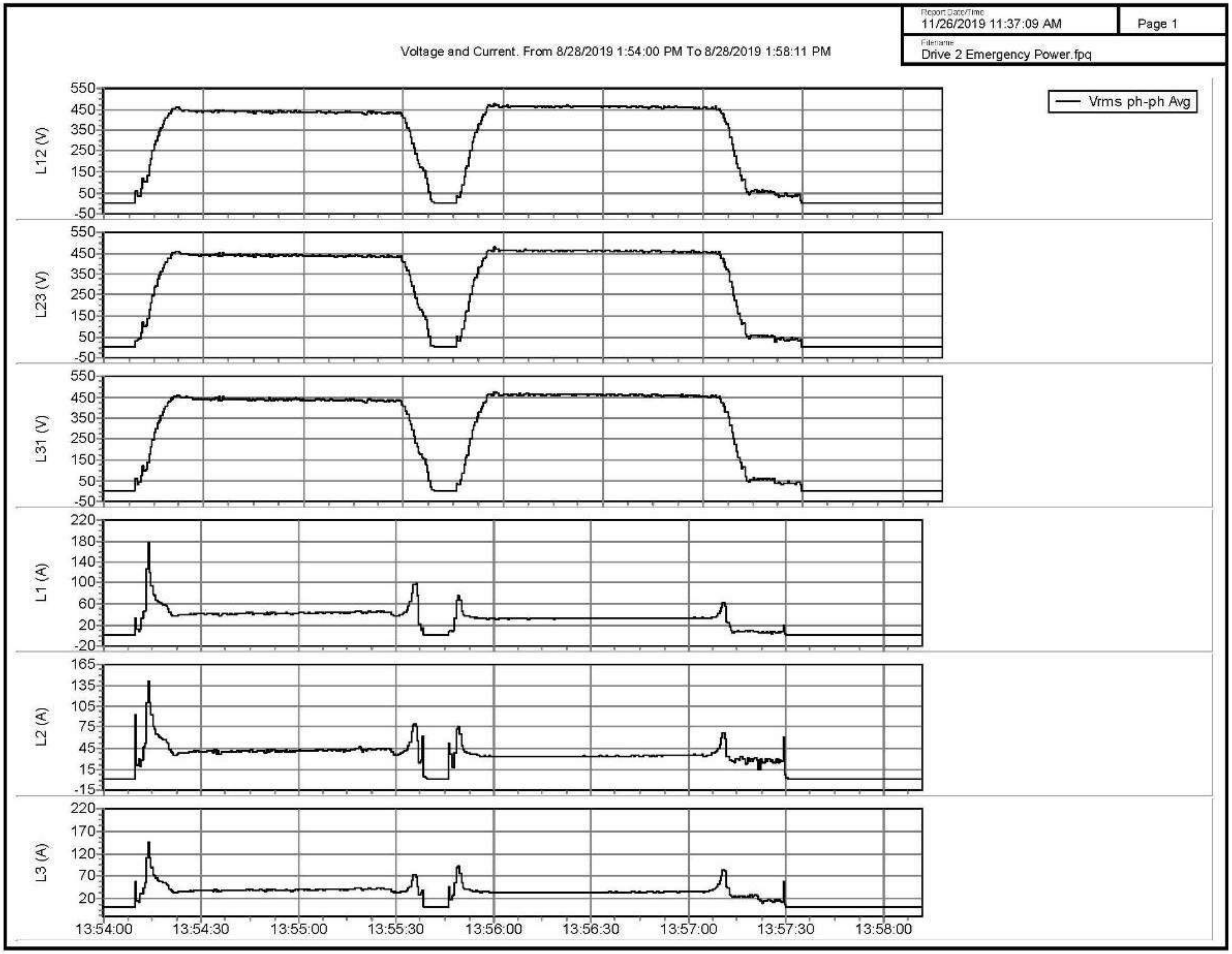


Figure 16: Voltage and Current Parameters (Span Drive Motor 2 Generator Power).

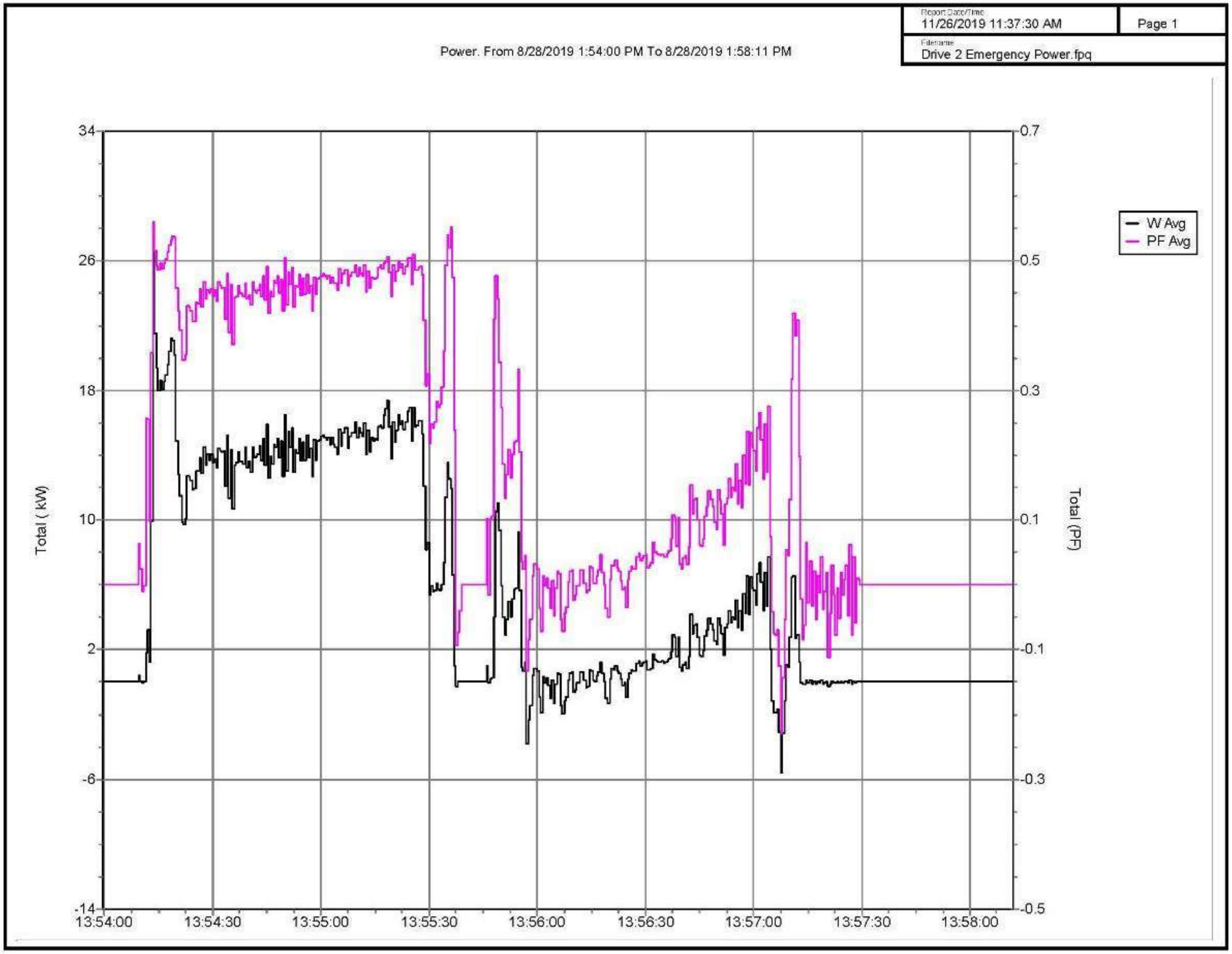


Figure 17: Power Parameters (Span Drive Motor 2 Generator Power).

(Note the motor is drawing more power during raising the span than lowering.)

10.3.6 ELECTRICAL INSULATION TESTING

As part of the electrical inspection the feeder cables and windings of all motor, brakes, and warning gates were insulation resistance tested using a 1,000-volt insulation resistance Megger test set with the following results. The weather conditions during the measurements were overcast and the temperature was approximately 21°C with 100% humidity.

Table 7: Insulation resistance test results

MOTOR/CABLE DESCRIPTION (ALL 3-PHASE)	RESISTANCE TO GROUND
Span Drive Motor No.1	>1,000 MΩ
Span Drive Motor No.2	>1,000 MΩ
Motor Brake 1&2 Feeder Cable	All >1,000 MΩ
Motor Brake 1	>1,000 MΩ
Motor Brake 2	>1,000 MΩ
Manual (Machinery) Brake	>1,000 MΩ
Span Lock Motor	13 MΩ
Gate #1 Feeder Cable	80/40/45 MΩ
Gate #2 Feeder Cable	28/28/55 MΩ
Gate #3 Feeder Cable	60/61/60 MΩ
Gate #4 Feeder Cable Phase C	115/113/120 MΩ

From the above results, it can be seen that the insulation resistances of all circuits are in good to excellent condition with the exception of the span lock motor, gate 1 feeders and gate 2 feeders that exhibit lower insulation resistance levels, these are still considered sufficient for reliable service in the long term but should be monitored on an annual basis.

Corrective action is required to:

1. Closely monitor the feeder cables for the span lock motor, span lock motor windings, gate 1 feeders and gate 2 feeders, replace as necessary in the long term.

10.4 Control Systems

The control system is comprised of a main control desk, relay logic controls and a control operator for three speed step control of the span main drive motors.

10.4.1 MAIN CONTROL DESK

The control desk was replaced as part of the bridge electrical rehabilitation in 1994. Numerous changes were made to the control desk during the 2012 rehabilitation and some safety interlocks were implemented into the bridge control system. Traffic gate and brake status indicators were added to the control desk as a part of that work. Additionally, a separate bypass control panel and a span position/motor speed indication panel has been added and mounted above the main control desk. The main control desk is located in the operator control house to provide the operator with complete view of the navigable channel and vehicular and pedestrian traffic approaching from the northwest.

The control desk contains necessary control pushbuttons, switches, indication lights and indicating meters to provide the operator with information and control functions to safely control the bridge. Additionally, a foot switch is provided at the control desk to interrupt operation during emergency situations and for the operator to stop the bridge during normal operation (Photo E18). The control desk is not laid out in a logical sequence and operation of the bridge by operators can be confusing.

As part of the recent span drive motor and motor controller replacement project, a few devices on the control desk were replaced such as switch, button, digital display meter, and indication lights. All replaced devices are in excellent working condition at the time of inspection.

The traffic gate indicator lights consist of mini LED type lights but are not sunlight glare readable. It is difficult to tell if these mini-LED indicators are illuminated under sunlight conditions.

Corrective actions are required as follows:

1. Replace traffic gate indicators with sunlight readable pilot lights in the short term.
2. Replace the operators control desk with a modern desk containing an HMI and logically laid out bridge control devices.

10.4.2 RELAY LOGIC

The bridge logic control consists of conventional relay logic that was installed during the 1994 bridge electrical system rehabilitation and has been modified several times. The control relays are located in a cabinet directly below the main control desk. The control relays are in good operating condition. Some additional relays were added to the relay cabinet as part of the 2012 rehabilitation project. Further modification to the existing relay logic system was implemented as part of the motor/drive replacement project. Additional logic modifications alleviated the previously found bridge control system interlock deficiencies for the traffic control equipment. The modifications also provided safety logic to ensure the span operating sequence is properly automated to eliminate possible operating human error (Photo E19).

The control system installation in the control desk is generally in poor condition with many wiring changes having been made for the various rehabilitation and upgrade projects that have taken place since the control system was installed. A great deal of the wiring is untagged, "As-Built" drawings, apart from the most recent drive project, are obsolete and the form of installation is today considered legacy technology. The present control logic, although operational, is very difficult to follow, has not been installed in a conventional or code compliant manner and maintenance and troubleshooting is extremely time consuming.

A separate E-Stop pushbutton has been provided in the machinery space to prevent electrical operation of the bridge drive system. This allows maintenance personnel to prevent or stop bridge operation when working in the machinery space (Photo E20).

A full-blown interlock test was performed on the traffic control system and the bridge operating system equipment and the bridge and traffic control system was found to be properly interlocked in accordance with code and good practice.

An additional toggle switch box was installed inside the cabinet in early 2019 to allow the bridge fully seated limit switch at the toe end of the bridge to be switches to the new lever switch installed in the cam switch box inside the machinery space as a backup form of bridge seating control when the water level is too high and submerges the span seated limit switch (Photo E19).

Corrective actions are required as follows:

1. Properly train all wires in the control desk wiring cabinet.
2. Properly label any wires with missing tags.
3. Replace the existing relay logic control system with a PLC based modern control system with appropriate diagnostics for speedy and accurate troubleshooting.

10.5 Operational Devices

Operational devices are defined as all electrical devices that contribute to and are part of the bridge operating system.

The operational device group includes the following items:

- Motor Overloads;
- Limit Switches;
- Span Position Limit Switches and Speed Switch.

10.5.1 MOTOR OVERLOADS

The main motor overloads were visually inspected as part of the inspection. The overloads are of the conventional bi-metal heater type that monitor the thermal effect of an overload condition of the motor it protects. The overloads were installed during the 1994 rehabilitation and are in good condition and appropriately sized for their prevailing duty. The new VFD drives have built in overload protection that provide enhanced motor protection and are in proper working order.

No corrective action is required.

10.5.2 LIMIT SWITCHES

Limit switches were inspected as part of the inspection. The following devices were visually inspected: Seated Limit Switches, Span Position Limit Switches, Brake Limit Switches, Span Lock Limit Switches and Over-travel Limit Switches. All switches are operational and in good serviceable condition.

No corrective action is required.

10.5.3 SEATED LIMIT SWITCHES

The bridge is provided with two (2) span seated limit switches, one at each corner of the toe end of the span. These switches are of the plunger type and are used to control and stop the span operation when fully seated. The switches are in good cosmetic condition. However, signs of water were found inside the north fully seated limit switch enclosure at the time of inspection. It was reported that this north fully seated limit switch had previously failed prior to the inspection and historically, it was reported that this switch had failed on several previous occasions (Photo E21). The water infiltration appears to be caused by a worn limit switch door gasket and its exposure to water, particularly during stormy conditions.

Corrective actions are required as follows:

1. Relocated the existing toe end plunger type span seated limit switches so it is outside of the high water level area.

10.5.3.1 Span Position Limit Switches and Speed Switch

Span position limit switch is used to monitor the span position at discrete bridge leaf positions (fully seated, nearly closed, nearly open, full open and over–travel).

The span position limit switch consists is of obsolete design but is operational and in serviceable condition. It consists of six (6) limit switches mounted in an enclosure in the machinery room with a target attached to a threaded auxiliary shaft to indicate the position of the span as it rotates. The limit switches are of Omron manufacture, they are of the holding type rotating lever switches. These limit switches are used for control and indicating purposes. All limit switches are in good operating condition (Photo E23).

In addition to the span position limit switches, an encoder/speed switch was installed as part of the 2012 rehabilitation project. The speed switch target is mounted on the main driving shaft of the bridge machinery with sensor monitoring the rotational speed of the target. This speed switch module is used to provide a measure of bridge angular position and motor speed at the operator's control desk (Photo E22). An analog signal from the speed switch tachometer module is utilized to feed a Laurel panel meter module and provides a second motor speed readout. Note that both modules are providing the read only outputs. Over speed warning and trip functions from this encoder/speed switch have not been integrated into the control system. If an overspeed situation occurs, it is the bridge operator's responsibility to take action manually. The absence of the overspeed trip/stop function is considered a major defect and potentially could cause severe damage to the bridge structure if the motor loses control of the span. Note that each drive is provided with an over speed trip function, but this should not be relied upon for bridge overspeed trip. The new VFD drive has built-in overspeed trip to de-energize the motors. However, the primary over-speed trip should be dictated by the overspeed switch and VFD built-in overspeed trip function should act as a backup.

Corrective action is required as follows:

1. Integrate the overspeed trip function to the control circuit such that span will be stopped (or E-stopped) if the motor loses the control of the span.

10.5.3.2 Over-Travel Limit Switches

Over-travel limit switches are present at two locations on the bridge. One is located in the span position limit switch enclosure and the second is located on the bridge fixed structure near and above the machinery room. Both are operational, in serviceable condition and perform the desired safety function for the bridge operating system (Photo E24).

No corrective action is required.

10.5.3.3 Span Lock Limit Switches

The Span Lock Limit Switches are located at each span lock and are operated by the lock arm to assure the span locks are pulled. The switches have been recently replaced with the rotary cam switches as part of recent span lock electrical system replacement and are in as new condition but do exhibit signs of corrosion (Photos E16 and E17).

Corrective action is required as follows:

1. Clean, remove corrosion and apply protective coating on the span lock RCLS enclosures.

10.6 Traffic Control

The Traffic Control system consists of Traffic Lights, Roadway Gates and Pedestrian Control.

10.6.1 TRAFFIC SIGNALS AND SIGNS

The traffic light installation consists of one (1) red/amber/green traffic signal suspended over the roadway from a pole mounted cantilevered arm on each side of the roadway at each approach to the bridge. While the bridge is open to vehicular traffic, the traffic signals are GREEN. During a bridge operation the traffic lights cycle to RED. Warning gongs are mounted on the south traffic signal poles. These gongs provide audible indication for the traveling public that the gates are lowering or ready to lower. The traffic signals and poles have been recently replaced and are in excellent condition (Photo E25).

Corrective action is required to:

1. Repair the non-operational east warning gong.

10.6.2 TRAFFIC GATES

The gates and gate electric service feeders were replaced as part of a 2012 rehabilitation project. At the time of the inspection, all traffic gate arms were unable to be raised to their full upright position. The gate mechanism motor starters are housed in the gate enclosures. This location exposes the gate motor starter equipment to the harsh outdoor environment and causes added effort in maintaining and troubleshooting (Photos E26 and E27). The following deficiencies were noted:

- Traffic gate position limit switches are not provided with a protective cover and exhibit moderate to heavy corrosion on the contacts (Photo E28).
- All gates are missing enclosure door limit switches. Although a code compliant sign has been installed to warn that the enclosure is powered and should be disconnected for maintenance this can potentially be dangerous. These switches are normally installed and used to prevent electrical operation of the gates when the doors are open (Photo E27).
- No hand crank limit switch is provided for any of the motor hand crank mechanisms to prevent gate electrical operation when the gate is being operated using the hand crank. This is a major safety concern for operating personnel when hand cranking the gates.
- The hand crank lever of the northwest traffic gate is missing.
- The wiring of the traffic gate motor starters has been poorly installed with wires improperly trained and many wires not properly labelled. This will make maintenance or troubleshooting of the gate starters difficult.
- No barrier gates are provided. CHBDC notes that "consideration" should be given to providing a gate at the toe end of the bridge.

Corrective action is required as follows:

1. Clean gate limit switch contact and provide protective covers.
2. Provide door limit switches and hand crank limit switches for each gate to prevent electrical operation of the gates during maintenance or manual operation.
3. Provide a hand crank handle for the northwest traffic gate.
4. Properly train and label the starter and control wiring inside the gate enclosures.
5. Consider furnishing new barrier gates at each of the bridge approaches. As a minimum, a barrier gates should be provided at the east approach to the bridge.
6. Consider replacing all warning gates with new gates that are suitable for the environment, provided with necessary safety limit switches, and with gate starters located in the MCC.

10.6.3 PEDESTRIAN CONTROL

Pedestrian control devices have been installed to signal pedestrians of bridge operation (Photo E25). They consist of pedestrian signals at the sidewalk approaches and are mounted on the traffic signal poles below the warning gongs. The signals were operating correctly at the time of inspection.

No corrective action is required.

10.6.4 AIDS TO NAVIGATION

The bridge is provided with red and green span navigation lights mounted at the center of the bridge on the truss beam on each side of the bridge for marine traffic signaling. The location of these navigation lights does not provide a clear indication signal to marine traffic due to their location when the span is fully open (Photo E29).

In addition to the span navigation lights, fender navigation lights have also been provided at the bridge piers. These fender lights were recently installed with LED type lights and are in very good operational condition (Photo E30).

Corrective action is required as follows:

1. Install additional pivot type red and green navigation lights mounted near the toe of the leaf for clear indication to marine traffic of the status of the bridge.

10.7 Conduits, Junction Boxes, Cable Trays and Suspension Cables

The bridge indoor electrical installation generally consists of RGS conduits and termination junction boxes. The installation is generally in good physical condition (Photo E39). The bridge outdoor electrical installation consists of numerous runs of RGS and flexible conduits and junction boxes (Photo E40). The submarine cable junction boxes have many wires that are unlabeled and some unterminated spare wires. Most of the junction boxes and submarine cable junction boxes have been replaced with stainless steel junction boxes as part of the 2012 rehabilitation project.

10.7.1 CONDUITS

The bridge conduits were recently painted. No sign of corrosion or significant physical deficiencies were noted at the time of inspection.

No corrective action is required.

10.7.2 JUNCTION BOXES

Many of the outdoor junction boxes were replaced with stainless steel junction boxes as part of a rehabilitation project. These junction boxes appear to be in good physical condition (Photo E34).

The submarine cable junction boxes also have many unterminated and unlabeled wires. The enclosures are covered with debris (Photo E32).

Most of the indoor junction boxes are in fair condition. No significant deficiencies were noted at the time of inspection.

Corrective action is required as follows:

1. Properly terminate all spare wires, and properly label wires in the outdoor junction boxes.
2. Replace the junction box at the bottom of the staircase leading to the machinery space at the NW corner of the span facing the control house (Photo E31).

10.7.3 SUBMARINE CABLES

Submarine cables are provided for the transition of power and control to the far side of the bridge for gates, traffic signals and fully seated limit switches. Several the submarine cables were replaced during the 2012 rehabilitation project along with the replacement of submarine cable junction boxes. However, some originally installed submarine cables were found at the time of inspection. It was unclear if these original submarine cables are still in service or if they have been taken out of service (Photo E33).

Corrective action is required as follows:

1. Investigate and determine if the original submarine cables are still in service. If it is determined that the original cables are not currently in service, they should be removed, or consideration given to maintaining the cable for use as a backup to the existing submarine cables. If this is pursued, ensure that the backup cable does not deteriorate with age. It is recommended that 120V be applied to each conductor within the backup cable, this would maintain a slight differential in temperature within the cable and protect the cable and cable insulation.
2. Properly label all wires inside the submarine cable junction boxes.

10.8 Grounding and Bonding

The inspection included a visual inspection of the bridge grounding and bonding installation. Ground resistance testing was not performed as part of the inspection as the recommendation in the 2018 CDI report was for the ground resistance testing to be performed as part of routine maintenance under the maintenance contractors' scope. The installation appears to be complete with the structure and the electrical installation grounded and bonded in accordance with Canadian Highway Bridge Design Code and Canadian Electrical Code (Photo E34).

Corrective action is required as follows:

1. Ensure that the ground integrity is maintained throughout the bridge structural steel and electrical system. This should take the form of ground resistance testing and should be performed annually.

10.9 Redundancy

The reliability of operation of the bridge can be greatly improved by introducing a redundant control system.

Corrective action is recommended as follows:

1. A redundant bridge control system is recommended such as providing a PLC controller with relay backup to increase reliability of operation for the bridge. See control system recommendation.

10.10 General Lighting and Fire Alarm

10.10.1 GENERAL LIGHTING

The status of the lighting and electrical installation associated with the control house is in good operational condition, with sufficient illumination levels for its function and no signs of corrosion or aging of the equipment and associated junction boxes or conduit installation (Photo E36). The lighting and associated electrical installation are expected to continue to operate in a reliable manner in the long term.

The lighting in the machinery space was recently replaced and provides sufficient illumination level for maintenance and troubleshooting of the machinery equipment (Photo E37).

Emergency lighting is provided in the operators control house, maintenance facility and the machinery space. The emergency lighting in the machinery space and operator's control house was tested and found to be in operational condition at the time of the inspection.

No corrective action is required.

10.10.2 FIRE ALARM SYSTEM

The bridge has been provided with a fire alarm system. The system consists of smoke detectors, horn/strobe unit, pull stations, a remote annunciator panel located in the control house and a fire alarm control panel located at the entrance of the maintenance facility (Photo E35). The fire alarm system was recently installed. All associated equipment is in as new condition. No deficiencies were noted at the time of inspection. A smoke detector and a pull station are also provided in the machinery space and its control is routed back to the annunciator panel in the control house and the main FACP in the maintenance building.

No corrective action is required.

10.11 CCTV system

A CCTV system was installed at the bridge in 2014. The CCTV cameras have been strategically located throughout the bridge to monitor the roadway approaches, waterway approaches and the machinery space. The operator can monitor these locations from the office space inside the maintenance facility. The camera installation provides good visual information and has been well installed and was operational at the time of the inspection (Photo E38).

No corrective action is required.

11. Overall Structure Rating

Based on the results of the 2017 Structural Evaluation Report, the 2018 Fatigue Inspection and Evaluation Report, the 2019 Comprehensive Detailed Inspection, and the 2020 Main Trunnion Rehabilitation Study – Structural Evaluation Report, the current Structural Condition Rating is 3 (Poor) and is unchanged from the 2018 Comprehensive Detailed Inspection Report. The rationalization for this rating is as follows:

- The 2018 fatigue inspection revealed cracks in leaf truss bottom chord members 14S-15S and 14S-16S, top chord members 3S-5S and 13N-16N, verticals 1N-2N and 9S-10S, and the gusset plates at connections 2N, 16N, and 16S. Cracks were also found in counterweight truss member 21N-27N, tower truss horizontals 15S-18S and 18S-19S, and in 25 stringers.
- The 2019 fatigue inspection revealed multiple lamination defects in leaf truss top chord member 1S-3S, new cracks occurring in leaf truss top chord member 1S-3S, main trunnion connection 15N/16N, tower truss horizontal 15S-18S, stringer G between FB10-FB12, and stringer I between FB14-FB16. The testing also revealed cracks that increased in length in top chord member 3S-5S, tower truss horizontal member 18S-19S, and in 11 stringers.
- Repairs are also required to other primary components including the main trunnion connections, concrete counterweight, leaf truss bottom chord members and connections, tower truss members and connections, coating system, and deck grating, and strengthening of the north and south leaf truss vertical members 1-2, 5-6, and 9-10 is recommended. Repairs are also recommended for multiple secondary components including bracing members in the leaf and tower trusses, mechanical platform, curbs and sidewalk, approach slabs, guide rails, marine structures, and catwalks and stairs.
- The results of the 2017 Structural Evaluation Report indicated that except for leaf truss diagonal members 9N-12N and 9S-12S the structure met the current CHBDC load cases for live loading requirements in the closed position. These deficient members were strengthened in 2017/18 so in theory the bridge now meets the live load requirements, although it should be noted that the evaluation has not been updated to account for the additional deterioration observed during the current inspection.

- The results of the 2020 Main Trunnion Rehabilitation Study – Structural Evaluation Report indicate that when the bridge is operated, i.e. in the open position, the structure does not satisfy CHBDC special load case requirements for moveable bridges, and four truss members (13-16, 14-15, 14-16 and 15-17) are significantly overstressed with maximum demand over capacity (D/C) ratios ranging from 1.62 to 2.11, and all four trunnion gusset plates are also overstressed. However, the maximum D/C ratios for members 13-16, 14-15, 14-16 and 15-17 become much lower (ranging from 1.26 to 1.68) when a reduced operating wind speed of 60km/h is used. When the bridge is in the closed position, i.e. open for road traffic, the six members evaluated have adequate resistance but both interior (north and south) gusset plates are locally overstressed. Therefore, if the requirements of the CHBDC are strictly adhered to, members 13-16, 14-15, 14-16 and 15-17, and all four gusset plates should be repaired or strengthened. It should be noted however, that the analyses performed showed that, contrary to what was expected, the forces in the main trunnion assemblies when the bridge is in the open position are mainly influenced by the wind and not by the operating impact.
- It is not known if the structure satisfies the seismic requirements of the current CHBDC. There have been significant changes to the seismic section of the CHBDC since the preliminary seismic study was carried out by McCormick Rankin Corporation in 2001, and the changes could result in a lower demand on structural elements. The 2017 CDI report indicated that a new seismic analysis was being carried out, but the results have not been provided to Parsons.

In the bridge's current configuration, the Functional Rating is 2 (Inadequate), and is unchanged from the 2018 Comprehensive Detailed Inspection Report. The rationalization for this rating is as follows:

- The clear distance between the timber curbs on the deck is approximately 7.30 m. Chapter 4 of the Geometric Design Guide for Canadian Roads (GDGCR) by the Transportation Association of Canada (TAC) states that for an urban road with a design speed of 60 km/h or less (the Causeway has a posted speed of 50 km/h), the minimum recommended lane width where buses and larger trucks are expected to regularly use a lane is 3.30 m (Table 4.2.3). The minimum distance from the edge of the lane to the inside face of the barrier/curb is 1.4m for bridges less than 50.0 m in length on urban arterial roads (Figure 4.10.3). The overall required width of the lanes is 6.60 m, leaving a clearance of 0.35 m on each side, therefore insufficient roadside clearance is provided.
- Section 3.3.5.5 of the GDGCR states that 5.0m vertical clearance is required for vehicular bridges over travelled lanes and shoulders. The structure's vertical clearance of 4.2 m is more than 10% below this requirement.
- The riding surface quality provided by the deck steel grating is generally poor, especially for cyclists.
- Section 6.3.1.2 of the GDGCR indicates that the practical lower limit of sidewalks is 1.5m. At several locations where the structural truss members pass through the sidewalk at deck level, the width is reduced to 1.2m.
- The existing thrie-beam traffic barriers on the bridge do not meet current CHBDC crash-tested requirements, and the beams are mounted directly to the road side of the through truss members, therefore there is a possibility that vehicle collision along the barrier could subject primary members of the main truss to damage or failure.
- The northeast, northwest, and southwest approach guide rails do not meet current MTO standards nor TAC requirements as the consistent post spacing does not provide a transition section that produces a gradual stiffening between the semi-rigid guide rail and the rigid truss members. This means that in their current configuration the guide rails may not be able to re-direct errant vehicles back onto the roadway which is a safety concern and could subject primary members of the tower truss or though truss to damage or failure. In addition, the timber posts in the southwest guide rail are breakaway type posts which may permit the

guide rail to deflect onto the sidewalk in the event of vehicle impact, which is a potential hazard to pedestrians.

12. Recommended Rehabilitation and Maintenance Work

The Bascule Bridge was built in 1917 and is now over 100 years old. The results of the 2019 CDI and several other recent studies indicate that significant repairs and/or replacement are required for several structural components including the steel deck grating system and stringers, the counterweight, the main trunnion connections, and many structural steel truss members.

The recent fatigue inspections of the steel truss members discovered that cracks have already occurred in some members, and it is likely that other as yet undetected cracks exist in the structure. While the vast majority of the cracks detected in the truss members were located at perforations caused by localized corrosion, lamination defects were detected in two Leaf Truss top chord members, and a crack was found in a Counterweight Truss member that has one of the lowest remaining fatigue life.

The bridge is also functionally deficient in terms of roadway and sidewalk width, vertical clearance, and riding surface quality, and the traffic barriers on the bridge do not meet current CHBDC crash-tested requirements. In addition, in 2017 and 2019, the very high spring water levels flooded the abutment bearing seats.

Given the structural and functional issues listed above, it is recommended that PSPC considers planning for the replacement of the bridge in the near future. In the meantime, numerous repairs are recommended to keep the bridge operational. The major structural, mechanical, and electrical components recommended for rehabilitation and ongoing maintenance items are discussed in the following sections.

12.1 Structural Recommendations

12.1.1 SUBSTRUCTURE

12.1.1.1 Wingwalls

The 10mm wide vertical crack in the southeast wingwall should be repaired once the cause of the approach slab and sidewalk settlement has been identified and rectified. In order to identify the cause of the settlement, drilling a borehole into the approaches and extracting core samples to review soil stratum may provide some useful information, such as whether a void is forming. The very severe spall at the east end of the southwest wingwall at the interface with the abutment wall should be repaired.

12.1.1.2 Bearing Seats

Repairs should be carried out to the area of severe scaling on the west bearing seat north of the truss, the shallow area of disintegration at the south end, and the three spalls. The east bearing seat requires repairs to the spalled area at the northeast corner.

12.1.1.3 Ballast Walls

The wide diagonal and vertical cracks and the holes at the bottom of the east ballast wall should be repaired.

12.1.1.4 Abutment Walls

The wide crack at the southeast end of the east abutment, and the large triangular void at the sheet pile/rip-rap interface at the south side of the west abutment should be repaired.

12.1.2 DECK GRATING

According to the As-built contract drawings "LaSalle Causeway – Repairs to Bridges" by C.C. Parker the current steel deck grating was designed in 1973 and installed in 1976, meaning it has been in service for almost 43 years. Approximately 23,000 vehicles cross the bridge per day.

Both the cross-bars and the bearing bars were originally serrated to provide traction for vehicular traffic, but the serrated edge has been completely worn away within the wheel tracks in each vehicular lane, and the bearing bars are worn up to an additional 3mm in between the cross-bars. The steel grating therefore no longer provides the same slip resistance as designed which could increase vehicle braking distances in poor weather conditions.

The coating (assumed to be galvanized) of the grating has typically deteriorated and there is light corrosion on the vertical faces of the cross bars and bearing bars and medium corrosion along the north and south edges.

Bent bearing and cross bars were observed throughout the grating, and broken bars were observed mostly at the west and east ends with some broken bars occurring in the middle. Cracked bar-to-bar and bar-to-sill welds were noted at several locations. Two groups of cracked longitudinal bars were noted at the intersection of Panels 15-16 A and B and Panels 15-16 C and D (at the west end) which required the temporary installation of steel plates. Various locations of bearing and cross bars have been previously repaired. Most of this deterioration of the grating is suspected to have been caused by impact damage which has caused numerous transverse cross bars to either bend and deform or completely break off at the bearing bar interface. In February 2017 a 370mm wide by 420mm long piece of grating failed and broke off from the remaining grating and the transverse sill beneath. Parsons's 2017 detailed grating inspection report states that multiple cracks were observed in the piece that broke free and the bearing bars surrounding the opening, with most of the cracks propagating from the notch for the cross bars and extending to the base of the metal. It appears from the wearing of the base of the longitudinal bearing bars at the sill that the welds had failed between the sills and the bearing bars first which caused the portion of the grating to vibrate which placed additional stress on the bearing bars which caused them to crack and fail. The grating at this location was immediately replaced, though not all bars were welded to the sills. The current inspection revealed that some of the welds at this location have now cracked.

Given the performance and serviceability issues discussed above it is recommended that capital allowances are made to replace the entire steel deck grating. Localized repairs due to fractures and broken welds can be expected in the interim. Although the CHBDC discourages the use of open-deck systems on moveable bridges due to concerns with salt-laden water causing deterioration to below-deck components, the 2020 *LaSalle Causeway Bascule Bridge Steel Deck Grating Replacement Study – Phase 1 Feasibility Assessment* by Parsons recommended that the deck be replaced in-kind within the next two years. Although a new closed deck system would be the preferable replacement option, the feasibility assessment found that this is not feasible due to a number of key issues; closed deck systems have greater dead load than open gratings, and also result in significantly higher wind loads being imparted on the structural members and mechanical system, which are already at or over capacity.

In the meantime, it is recommended that the sections of panels 15-16 A and B and Panels 15-16 C and D (at the west end) that exhibit numerous cracked longitudinal bars are replaced. These repairs will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

12.1.3 DECK JOINTS

During the inspection it was determined that significant sections of the steel armouring angles atop the ballast walls sounded hollow when tapped with a hammer, indicating either delaminated concrete or a void between the armouring and the underlying concrete. In January 2020, PSPC reported that the section of the east armouring directly to the north of the centerline of the roadway was loose. A temporary repair with epoxy and rebar embedded into the concrete and welded to the angles was carried out in early February, but by late February the angle was once again loose. This was subsequently repaired again in early March with threaded rods and more epoxy.

It is recommended that the angles at both ends of the deck are removed, repairs to the underlying concrete ballast wall made, and new angles installed. These repairs will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

12.1.4 STRUCTURAL STEEL

All the repairs identified *in italics* in Sections 12.1.4.1 to 12.1.4.3 will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

12.1.4.1 Leaf/Through Truss Members and Connections

Top Chord

13N-16N: The crack found at the location of the impact damaged was removed by grinding during the 2018 fatigue inspection, and no crack was observed during the 2019 inspection. This location will be retested by Magnetic Particle Testing (MT) to confirm the crack has been fully removed and has not reoccurred. If a crack is again found, the anticipated repair would be to remove the crack by grinding.

1S-3S: During the inspection, lamination defects, generally parallel to the direction of the applied stresses were observed in the lower inboard flange. Small cracks were also observed. Removal of the lamination defects will be accomplished by trimming approximately half of the outstanding flange width at the defect location. Non-Destructive Testing (ultrasonic testing) will be performed prior to trimming to confirm the exact width of flange to be trimmed. If ultrasonic testing shows the lamination to be more than two-thirds of the width of the flange, trimming will be substituted by a repair identical to 3S-5S, with new channels on each side of the existing damaged channel.

3S-5S: Reinforce the north channel at the location of the 80mm lamination defect (with a 60mm crack) with a slip-critical bolted connection. The defect should be monitored until the member is repaired to ensure the defect/crack does not propagate.

Bottom Chord

0N-2N: Inspection by Magnetic Particle Testing, grinding of the perimeter of the defect, drilling the crack (when required) and installing a pretensioned bolt.

14N-16N: The perforated inboard (south) channel web near 16N should be strengthened with a slip-critical bolted connection and the missing coating repaired to arrest further corrosion (Priority B). This repair should be carried out as part of the Main Trunnion Rehabilitation project.

0S-2S: Inspection by Magnetic Particle Testing, grinding of the perimeter of the defect, drilling the crack (when required) and installing a pretensioned bolt.

14S-15S: Grind smooth the multiple cracks and the edges of the perforation in the bottom batten plate near 14S.

14S-16S: Grind smooth the 12mm long crack and the edges of the perforation in the north channel web and strengthen the channel with a slip-critical bolted connection. The 13 rivets in the south channel connection to 16S with over 75% section loss of the rivet head should be replaced with bolts (Priority B). The cause of the deformation of the member near 16S is not known, but it should be closely monitored during future inspections. The baseline measurements recorded in May 2020 are contained in Appendix J.

Diagonals

12N-13N: The cause of the deformation of the member near 13N is not known. The member was strengthened in 2010 and was replaced entirely at some point prior to this. It is recommended that baseline deformation measurements are taken during the 2021 CDI and closely monitored in subsequent inspections.

8S-9S: Inspection with Magnetic Particle Testing at locations of known cracking, and grinding of the cracks.

Verticals

1N-2N: Grind smooth the suspected crack or drill a hole at the end of crack and install a bolt with nut and washer. The crack should be monitored until the member is repaired to ensure it does not propagate. The deformation of the outstanding leg of the southwest angle above the bottom chord should be monitored during future inspections.

9S-10S: Remove the sign support angle to enable the grinding out of the crack in the top of the southeast flange at the previous weld location, and perform Magnetic Particle Testing to check for additional cracks. The crack should be monitored in the interim to ensure it does not propagate.

North and south members 1-2, 5-6, and 9-10: In 2016, cracks were discovered in the interior angles of vertical 13N-14N. Those cracks were repaired in 2017 by the addition of bolted steel elements. The cracks originated from a rivet hole, just above a discontinuity in the web plate of the vertical. Vertical 13S-14S was also reinforced in 2017, even if no cracks were detected in the member. All similar details were inspected during the fatigue inspection and no cracks were detected. However, the detail where cracking occurred in 13N-14N is prone to concentrated stress in the angles and creates a high local stress range when the bridge is open or under vehicular traffic loading. Since the floor beam connects to the interior gusset plate, the interior angles of the verticals most probably take a greater load than the outer angles. Secondary bending in the vertical caused by the connection of floor beams to verticals, shear lag and bending stiffness changes at discontinuities in the web all contribute to concentrating stress in the angles at the location where cracking occurred in 13N-14N. Therefore, it would be beneficial to reinforce the other vertical members with the same detail as 13N-14N and 13S-14S to prevent cracking (Priority C). In the interim, these members should be closely monitored for cracks during future inspections.

Connections

2N: The inboard (south) gusset plate of 2N has multiple laminations through the thickness over the full height of the plate, and full-width horizontal hairline cracks were identified in both the east and west sides of the gusset plate. A structural analysis was carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002) and it was determined that the existing floor beam connection plates have sufficient capacity to carry the loads previously carried by the inboard gusset plate and no repair is required.

The 2017 Structural Evaluation Report incorporated the deterioration observed during the 2015 Detailed Measurements project and the 2016 Comprehensive Detailed Inspection Report (both by Parsons) in calculating the remaining capacity of the leaf truss connections under live load. The connections were not evaluated for special load cases. The report states that it "*was found that even with measured section losses that the connections had sufficient reserve capacity for live loads.*" In general, the deterioration noted at the connections during the current inspection is not significantly greater than the deterioration noted during the previous inspections as the coating is still intact and no active corrosion is occurring, therefore it can be assumed that the connections still have adequate capacity and that no repairs are required at this stage, other than those indicated above.

12.1.4.2 Tower Truss

Members

15N-17N, 15S-17S: Drill drainage holes in 15N-17N and 15S-17S at nodes 15N and 15S respectively to prevent the accumulation of water inside the members which has caused severe corrosion of the members and rivet heads, and the main trunnion bolt heads and stiffening angles.

15S-18S: Grind smooth the crack and the perimeter of the perforation in the south channel and reinforce the element with a slip-critical bolted connection.

18S-19S: Grind smooth the crack and the perimeter of the perforation in the south channel and reinforce the element with a slip-critical bolted connection.

18N-19N: The severe section loss of the interior channel flanges and rivet heads and the perforations in the upper and lower batten plates at node 19N should be repaired (Priority B).

19S-20S: The six rivet heads with 70% localized section loss at the base of this vertical member should be replaced with bolts (Priority C).

15N-17N, 15S-17S: It is recommended that the section loss of these members at nodes 15N and 15S is measured and appropriate repair details developed during the upcoming main trunnion rehabilitation project.

Connections

15N: The severe localized pitting, perforations, and deteriorated rivet head in the inboard gusset plate at roadway level should be repaired as part of the upcoming main trunnion rehabilitation project (Priority B).

18N: The section loss and perforation in the gusset plates along the top flange of members 15N-18N and 18N-19N should be repaired and localized coating repairs carried out to arrest the active corrosion (Priority B)

19N: Repair the perforations and the localized severe pitting in the gusset plates at the interfaces with the vertical flange of vertical member 19N-20N and the bottom flange of horizontal member 18N-19N. The rivet heads with severe section loss at the base of the gusset plates should be replaced (Priority B).

15S: The severe localized pitting and perforation in the inboard gusset plate at roadway level should be repaired as part of the upcoming main trunnion rehabilitation project (Priority B).

The 2017 Structural Evaluation Report states: "*Connections on the counterweight truss and tower truss were found to have a low participation for live load and were excluded from live load evaluation*." The connections were not evaluated for special load cases. It is therefore not known what the exact effect the observed deterioration has on the capacity of the connections, and this should be confirmed prior to the development of design details.

12.1.4.3 Counterweight Truss

21N-27N: The member has a crack through the full width of the outstanding leg of the bottom interior angle at 27N which should be repaired with a slip-critical bolted connection (Priority A). It is recommended that monthly inspections of the affected area are carried out if the bridge is lifted prior to the repair being performed.

21S-27N: The northwest end of this cross bracing member at 27N has 100% section loss over the full width of the horizontal lower leg plus many small perforations, and although the member has been previously strengthened, the angle that was added has not addressed the connection of the lower angle to the gusset plate. It is recommended that the repair detail is modified accordingly.

21S-27S: The results of the fatigue evaluation indicate that members 21N-27N and 21S-27S have one of the shortest residual lives of all members and given the discovery of the crack in the bottom interior angle of 21N-27N, it is recommended that 21S-27S is carefully monitored for signs of cracking during future inspections.

26N-26S: Drill drainage holes in member to prevent the accumulation of water inside the member.

12.1.4.4 Operating Pinion Struts

The exposed sections of struts 17N and 17S inside the mechanical housing should be cleaned and coated to arrest the moderate to severe active corrosion noted.

12.1.4.5 Main Trunnion Connections

The main trunnion connections at nodes 15N/16N and 15S/16S each comprise two large vertical gusset plates connecting bottom chord members 14-16 and 14-15, top chord member 13-16, and member 15-16 to the main trunnion pins. There are cracks propagating from perforations at the bottom of the south vertical gusset plate of 16N and the north vertical gusset plate of 16S between the end of the bottom chord members 14-16 and FB16. Severe localized pitting in the gusset plates is typical and there is very severe section loss of six and 13 rivet heads at 16N and 16S respectively. Perforations were noted in the triangular plates behind FB16. The upper section of the north (roadside) gusset plate of 15S/16S adjacent to the trunnion collar has widespread very severe pitting.

A project to rehabilitate the main trunnion connections and connecting members is planned to start in early 2021 with construction to commence later that year. The scope of repairs and strengthening will be based on the findings of Parsons' 2020 Main Trunnion Rehabilitation Study – Structural Evaluation Report. Repairs are therefore not recommended at this time, except for grinding smooth the cracks and the perimeter of the perforation in the vertical gusset plates at 16N and 16S to minimize stress concentrations, then installing slip critical bolted plates where possible. A bolt will also be installed at the tip of the cracks to try to stop or slow propagation. These repairs will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002). The perforations should be monitored until the members are repaired to ensure the cracks do not propagate.

12.1.4.6 Stringers

All the roadway stingers were constructed with an abrupt 90-degree cope (with no radius) in the top and bottom of the member at the clip angle connection to the floor beams. These copes are a fatigue-prone detail. Magnetic particle testing was carried out at locations where cracks in the coating, crack-like indications, or visible cracks in the stringers were previously documented. The testing revealed cracks have initiated at the top and/or bottom cope in 28 of the 72 stringers, including in six adjacent stringers in bay FB14-FB16. Some of the cracks appear to have progressed since the 2018 inspection. The stringers are in generally good material condition otherwise.

In the short term it is recommended that a hole is drilled at the end of the longer cracks to arrest further propagation and bolts with nuts and washers installed in the holes. The smaller cracks could be ground out. At the bottom cope, it is recommended that the poor coping detail is eliminated in all stringers by creating a 35mm radius in the web cope. It is likely that additional stringers will develop cracks over time, therefore it is also recommended that prior to the repairs being carried out additional magnetic particle testing is carried out for all the remaining stringers. These repairs will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

Although the stringers are not fracture-critical members, if further cracks do develop the replacement of the stringers during the recommended steel deck grating replacement should be considered.

12.1.4.7 Sills

The sidewalk ends of some sill members were noted as being deformed, and the majority of the sills below the roadway have permanent dead-load deflection. There is widespread light corrosion on the top surface of the top flange where the coating has failed, and several anchor bolts connecting the sills to the stringers below are missing, loose, or severely corroded. The sills above stringer F between FB14-FB16 have a 6mm gap between the sills and the stringer. In the short term it is recommended that missing bolts are replaced, and loose bolts tightened and gaps between the stringers and sills are shimmed. These repairs will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

The deck grating panels are welded to the top flange of the sills and removing these welds when the deck grating is replaced will be labour-intensive and costly. It is therefore recommended that the sills are replaced in conjunction with the deck grating.

12.1.4.8 Roadway Floor Beams

The roadway floor beams are welded plate members and are in generally good condition, however localized deformation over the height of the web of up to 16mm from straight was noted in FB8, FB10, FB12, and FB14. The cause of the deformation is not clear, but it should be closely monitored during future inspections. Bolts should be installed in the 18 holes at the midspan of FB0 relating to the original air buffer mechanism.

A potential fatigue prone detail has been identified at the three weld intersections located at the top and at the bottom of the end plates connecting the floorbeam to the trusses. This creates constraints that could induce cracking in the web of the floorbeam or in the welds. So far, no cracking has been found on the floorbeam, but only a small sample size was recently tested using Magnetic Particle Testing. All such locations will be inspected by Magnetic Particle Testing as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002) and any cracks discovered will be grinded.

12.1.4.9 Leaf Truss Sway Bracing

The damaged and deformed bottom angle above the westbound lane of member 5S-5N should be repaired.

12.1.4.10 Tower Truss Sway Bracing

The built-up sway bracing between 20N-20S and 21N-21S requires repairs to the angles with severe pitting and perforated batten plates at node 20N. Seven rivet heads near 20N and four rivet heads on the east side of bottom angle near 20S require replacement.

12.1.4.11 Tack Welds

Tack welds were noted on primary truss members 3N-4N, 7S-8S, 9N-10N, 9S-10S, 11N-12N, and at 0N and 0S. *It is recommended to grind the welds smooth and perform magnetic particle testing for cracks at these locations during the upcoming 2021 Structural Steel Repairs contract (R.097736.002).* In the interim, these locations should be closely monitored for cracks during future inspections.

12.1.4.12 Future Fatigue Inspections

Previous inspections found several fatigue cracks in main members and secondary members. The 2019 CDI confirmed that some of the cracks found previously are active (crack growth) and found new cracks (stringer copes, 1S-3S top chord). The cracks found can be separated in five categories: cracking at poor details (beam copes), cracking at sharp indentations created by corrosion (e.g.: 15S-18S), cracking caused by internal defects (e.g.: lamination defects of top chord between 1S and 5S, lamination in inner gusset plate at 2N, etc.), cracking at poorly executed welds (e.g. 9S-10S) and cracking at the gross section without obvious cause (21N-27N). The first four categories are common and are likely to develop in members with a substantial loading cycle history. The latter category is less common in typical bridge structures. However, Strauss Bascule Bridges are known to develop fatigue cracking in the counterweight truss, as mentioned in Chapter 10, section 4 of the AREMA *Bridge Inspection Handbook* (2007), and based on these observations and the discovery of the crack in 21N-27N, the discovery of other fatigue cracks in the counterweight truss in the upcoming years is to be anticipated. It is to be noted that the fatigue loading of the counterweight truss is independent of the live load (trains or trucks) and is entirely dependent on the number of opening cycles, thus observations made for the fatigue cracking on the counterweight truss of railroad Strauss Bascule bridges can be transferred to roadway Strauss Bascule bridges.

The hands-on and targeted NDT inspection of all members performed during the 2019 CDI is the most reliable way to find cracks in steel structure. However, it should be noted that even the most careful inspection of a steel structure cannot detect all cracks for a number of reasons, such as the length of the crack being too small to be seen by eye, and the crack being located in invisible locations (e.g., under rivet heads, in the interior of a sandwiched plate, under paint, etc.) As stated in Section 7.5 "Methods for Inspection for Fatigue Cracking" of the National Steel Bridge Alliance (NSBA) document *A Fatigue Primer for Structural Engineers*, "*Experience has shown that cracks have generally propagated in depth to between one-quarter to one-half the thickness of the part before the paint film is broken, which permits the oxide to form. Cracks smaller than this are not likely to be detected visually unless the paint, mill scale, and dirt have been removed by blast-cleaning the suspect area*". Thus, it probable that as yet undetected cracks exist in the structure. For this reason, regular targeted fatigue inspections with NDT support are of paramount importance to detect cracking as early as possible.

12.1.5 STRUCTURAL STEEL COATING

Although the current coating system only dates from the 2009/2010 rehabilitation, localized defects are evident at numerous locations. Defects noted include cracking (coating-related), under-film corrosion and peeling (adhesion-related), and pinholing, edge defects, runs, and sags (application-related). Physical damage in the form of chips and scrapes was also noted. The majority of the defects are on the tower truss members at roadway level, the leaf truss floor system and bracing members, and the leaf truss members at and below deck level. The poor coating application on the recently rehabilitated span lock mechanisms and live load supports is a contractual deficiency and should be rectified. It is recommended that localized repairs to the deteriorated coating system are carried out within 3 years (Priority B). All surface preparation and coating repairs should be inspected and approved by an experienced coating inspector.

Localized repairs to the coating system at locations where strain gauges were installed in 2019 as part of the Main Trunnion Rehabilitation Study will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

12.1.6 PIN AND HANGER BEARINGS

Refer to the Mechanical Recommendations section for work related to the Main Trunnion Bearings, Counterweight Trunnion Bearings, First Link Pin Bearings, and Second Link Pin Bearings.

Phased Array Ultrasonic Testing of the Counterweight Trunnion pins at 21N and 21S will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002) to determine if the corrosion detected in 2018 is progressing.

12.1.7 CONCRETE COUNTERWEIGHT AND HOUSING

It is our understanding that the concrete counterweight originates from the original construction of the bridge in 1917 and is therefore currently over 100 years old. It is not known if repairs have been carried out to the counterweight in the past. The only work known to have been done on the counterweight is the recent removal of loose debris that occurred in October 2019. All except the north and south faces of the counterweight are covered with what appear to be corrugated metal roofing panels. It is not known what material the panels are fabricated from or when they were installed. It should be noted that the metal panels do not provide any structural containment for the concrete. While the panels do provide some protection to the underlying concrete from the elements, they are not watertight, and once the concrete gets wet it cannot dry out properly due to the panels hindering evaporation of the water. The panels are starting to corrode (particularly on the underside) and there are two small perforations near the doors in the east face that should be repaired. The doors themselves are in poor condition, are difficult to open, and require repair. Damp stains, large areas of light corrosion, stalactites, and impact damage were noted on the panels on the underside of the counterweight.

The visible portions of the concrete counterweight surface (including at core locations extracted during the 2018 CDI) exhibit significant deterioration, including isolated and pattern cracks, delaminated areas, scaling, efflorescence, wet and damp areas, spalling, and disintegration. Disintegrated concrete and other debris have collected between the concrete and the metal panels with most of the debris accumulating in the northeast corner. Gaps between the panels are permitting smaller pieces of aggregate from the disintegrated counterweight concrete to fall onto the roadway below. As much of the loose debris was removed from the counterweight as possible during the current inspection, with the total amount removed is estimated to be about 45 to 70 kg (100 to 150 lb.).

Concrete cores were extracted as part of the 2018 inspection, and the following describes the results. While the concrete in the core extracted from the top of the north end of the west face was found to be mostly sound (but still exhibited cracks), the cores extracted from near the bottom of the east and west faces at the north end contained very little sound concrete. The results of the laboratory testing of the concrete cores extracted from the counterweight indicate that the concrete has a compressive strength of 11.9 MPa and is considered non-air entrained. Although the chloride ion content values were determined to be below the threshold required to initiate corrosion according to Section 5.4.3 of the MTO SRM, severe corrosion of the wire mesh reinforcing was observed at core locations.

The steel plates covering the north and south faces are in generally good condition overall although some localized areas of deep pitting were noted, particularly in the north plate near node 26N. Some nuts on the ends of the tie rods are loose or are missing.

It is recommended that a major rehabilitation of the counterweight is carried out within the next two years (Priority B). It is our understanding that a study is currently being carried out (by others) to determine the condition of the concrete towards the centre of the counterweight, and to identify the most practical and feasible rehabilitation method and extent.

12.1.8 CURBS AND SIDEWALK

The nuts missing from the bolts on the curb should be replaced, and the missing anchor at the east end of the north curb replaced. The screw heads protruding from the planks at the west end of the sidewalk should be driven below the surface of the sidewalk. The missing nuts on the bolts securing the sidewalk planks at the roadway end should be replaced, and the incorrect anchorage of the south curb at the west end should be modified. Planks showing severe end splitting and end checks should be replaced.

12.1.9 ROADWAY RAILINGS

The existing roadway railings do not meet current CHBDC crash-tested requirements (in terms of geometry and direct attachment to the truss) for bridge barriers and could subject primary members of the main truss to damage or failure during vehicle collision along the barrier. However, on a truss bridge with an open steel deck grating like this one, it has to be recognized that replacing or upgrading the railings to a crash-tested design in accordance with the requirements and loading of the current CHBDC would be difficult. No accident or collision records for the bridge were reviewed as part of the inspection, but it appears that there has been no recent significant damage to the existing traffic railings, which are protected by timber curbs. PSPC should consider accepting the liability of the railings not meeting CHBDC crash-tested requirements following a detailed review of the performance of the railing system based on accident history.

The post at the east end of the south railing is anchored with lag bolts into the sidewalk planks below. This anchorage should be modified.

The south railing currently has a large gap at the trunnion which could allow a pedestrian to fall into the roadway. A chain or railing should be installed to prevent this from occurring.

The bolts missing from the thrie-beam splices should be replaced.

12.1.10 ABUTMENT BEARINGS / LIVE LOAD SUPPORTS

The bent and severely corroded northwest anchor bolt of the south bearing should be replaced.

The issue with the north side of the leaf span being not fully seated is believed to be related to the elevation of the north buffer strike plate, which will be addressed as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002). Much of the light corrosion on the steel plates of the north and south bearings is a deficiency from the recent Span Lock project.

12.1.11 APPROACH SLABS

The concrete approach slabs do not have an asphalt wearing surface and widespread abrasion/wear from vehicles is typical. The worn painted shared vehicle/bicycle lane symbol in the westbound lane should be repainted. The wide cracks and small potholes at the interface with the exposed top of the ballast walls and at the ends of the slabs should be sealed and repaired respectively. The two wide transverse cracks near the centre of the east slab should also be repaired. These will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

12.1.12 GUIDE RAILS

The spacing of the posts in the northeast, northwest, and southwest guide rails is constant along the length of the guide rails. Both the TAC Geometric Design Guide for Canadian Roads and current MTO standards require the post spacing to reduce adjacent to the structure so that a transition section is provided that produces a gradual stiffening between the semi-rigid guide rail and rigid objects such as bridge barriers or in this case the tower truss members. In addition, the timber posts in the southwest guide rail are breakaway type posts which may permit the guide rail to deflect onto the sidewalk in the event of vehicle impact, which is a potential hazard to pedestrians. It is therefore recommended that the existing guide rails are modified (or replaced) to meet current MTO standards and TAC requirements.

The 7th and 8th posts from the west end of the southwest guiderail have been damaged by vehicular impact and require replacement. Minor impact damage to the east end treatment of the northeast guiderail should be repaired. The slight deformations in the 5th post from the east in the northeast guiderail, and 2nd and 3rd posts from the west in the northwest guiderail should also be repaired.

12.1.13 MECHANICAL PLATFORM AND HOUSING

During recent inspections, water was noted leaking into the mechanical room housing on the north side, near the centre, and in the northwest corner at the west end of the north motor support beam. A system of two metal trays leading to a bucket was installed to catch leaking water from the roof. To avoid potential water damage, repairs to the roofing membrane are recommended.

The limited condition survey performed as part of this work revealed that the soffit of the slab to be generally in fair-to-poor condition, with widespread light to moderate scaling, honeycombing, spalls, delaminated areas over traffic lanes, and medium cracks. The delaminated areas were scaled in 2020, but any additional areas that develop should be scaled as a matter of urgency to prevent them from falling onto traffic below, and the soffit should be regularly monitored for additional delaminations until the slab is rehabilitated. The soffit of the slab should be repaired in the short term. The repair could consist of removals down to sound concrete, mechanically anchoring galvanized wire mesh or reinforcing steel dowels into the slab and casting a new concrete soffit. No repairs are required to the top surface of the slab which is in good condition.

The area of 50% to 70% of section loss in the southeast angled brace bottom flange should be repaired.

12.1.14 CATWALKS AND STAIRS

There are currently no safety chains or gates at openings in railings or fall-arrest cables at ladders, which are potential safety hazards. A complete Health and Safety review/audit of the stairs and catwalks should be carried out to identify all locations of potential falling hazards. Following the review appropriate safety gates, chains, and fall-arrest cable systems at ladders should be installed in accordance with current regulatory requirements.

The perforated support members at the north and south ends below catwalk 21N-21S should be repaired, the split and/or cracked railing posts of catwalks 17N-17S and 21-27 should be repaired or replaced, and repairs carried out to the cracked welded railing connections of 22N-22S. The split and/or cracked railing posts of stairs 15S-17S, 17N-21N, and 17S-21S should be repaired or replaced.

12.1.15 SIGNS

The east Low Clearance sign was removed from member 1S-1N and put on a timber post at the northeast corner during the inspection due to the cracked welds noted on the sign bracket. The sign should be reinstalled on member 1S-1N with a bolted connection as soon as possible.

12.1.16 MARINE STRUCTURES

Walers exhibiting severe checks or splits should be replaced to ensure structural integrity of the fender wall. Missing nuts in the southeast fender wall should be replaced, and loose bolts should be tightened. The corroded and loose lower set of steel cables securing the structure to the south dolphin should be tightened or replaced. The fourth and fifth safety line posts from the north end of the southwest marine structure that are loose should be secured, and the wooden post near the north end should be replaced with a steel post. The pile clusters of the southwest fender wall should be replaced as they show little to no structural strength.

12.1.17 REHABILITATION AND MAINTENANCE SCHEDULE

Given the structural and functional deficiencies discussed in the preceding sections it is recommended that rehabilitation of the structure is carried out to address the required repairs. The timelines for the recommended rehabilitation work and maintenance are as follows:

Priority U (Urgent):

- **Signs:** Reinstall the Low Clearance sign on the east portal frame (1S-1N).

Priority M (Maintenance):

- **Counterweight Truss:** Remove debris collecting on member 26N-26S.
- **Timber Curbs and Sidewalk**: The screw heads protruding from the sidewalk timber planks at the west end should be driven below the surface of the sidewalk.
- **Approach Slabs:** Repaint worn shared vehicle/bicycle lane symbol in the westbound lane on the east approach.
- **Mechanical Housing Soffit:** Regularly monitor the soffit for additional delaminations and scale as necessary.

Priority S (Studies/Investigations/Surveys):

- **Access Platforms, Catwalks, Stairs, and Ladders:** Carry out a complete Health and Safety review/audit of the stairs and catwalks to identify all locations of potential falling hazards. Following the review appropriate safety gates, chains, and fall-arrest cable systems at ladders should be installed in accordance with current regulatory requirements.
- **Roadway Floor Beams:** Roadway floor beams FB8, FB10, FB12, and FB14 exhibit localized deformation of the web of up to 16mm from straight. As the cause of the deformation is not clear, the floor beams should be closely monitored during future inspections.
- **Deformation of 12N-13N:** Take detailed baseline measurements of the deformation during the 2021 CDI and monitor during future inspections.
- **Deformation of 14S-16S:** The cause of the deformation of the bottom chord member near 16S is not known, but it should be closely monitored during future inspections.
- **Fatigue Inspections:** The results of the fatigue evaluation indicate that members 21N-27N and 21S-27S have one of the shortest residual lives of all members and given the discovery of the crack in the bottom interior angle of 21N-27N, it is recommended that 21S-27S is carefully monitored for signs of cracking during future inspections. It is also recommended that targeted fatigue inspections with NDT support of all structural steel members are carried out on a regular basis (every two years).

Priority Code A (Within 1 Year):

The following repairs will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002):

- **Approach Slab Repairs:** Repair spalls and seal cracks in the approach slabs.
- **Abutment Bearings / Live Load Supports:** Add shims to the north live load support to address the issue of the span not seating at this corner. The four mounting bolts will need to be destructively removed and replaced. Clean and paint the areas of corrosion on the underside of the strike plates and the top of the supports.
- **Pin and Hanger Bearings:** Carry out *Phased Array Ultrasonic Testing* of the Counterweight Trunnion pins during the design phase at 21N and 21S to determine if the corrosion detected in 2018 is progressing.
- **Structural Steel Coating System:** Localized repairs to the coating system at locations where strain gauges were installed in 2019 as part of the Main Trunnion Rehabilitation Study.
- **Welds on Truss Members:** It is recommended to grind the welds on truss members 3N-4N, 7S-8S, 9N-10N, 9S-10S, 11N-12N, and at 0N and 0S smooth and perform magnetic particle testing for cracks at these locations.

- **Roadway Floor Beams:** Carry out Magnetic Particle Testing of the potential fatigue prone detail at the intersecting three welds located at the top and at the bottom of the end plates connecting the floorbeam to the trusses.
- **Deck Grating:** Replace the sections of deck grating panels 15-16 A and B and Panels 15-16 C and D (at the west end) that exhibit numerous cracked longitudinal bars.
- **Stringers:** Drill holes at the ends of the longer cracks in the stringer web copes and install bolts with nuts and washers. Grind out the smaller cracks. Carry out additional magnetic particle testing for all remaining stringers. Eliminate the 90-degree coping detail in all stringers by creating a 35mm radius in the web cope.
- **Sills:** Replace the missing bolts, tighten any loose bolts, and shim gaps between stringers.
- **Deck Joints:** Replace the armouring angles atop ballast walls at both abutments.
- **Structural Steel Repairs:**

ELEMENT	MEMBER	DETAILS
Leaf Truss Top Chord	1S-3S	Trim lower inboard flange to eliminate lamination defects.
	3S-5S	Reinforce the north channel at the location of the 80mm lamination defect and 60mm crack.
	13N-16N	Re-inspect by Magnetic Particle testing to ensure crack grinded out in 2019 has not reoccurred.
Leaf Truss Bottom Chord	0N-2N	Inspect by Magnetic Particle Testing, grind the perimeter of the defect, drill the crack (when required) and install a pretensioned bolt.
	0S-2S	Inspect by Magnetic Particle Testing, grind the perimeter of the defect, drill the crack (when required) and install a pretensioned bolt.
	14S-15S	Grind smooth the multiple cracks and the edges of the perforation in the bottom batten plate near 14S.
	14S-16S	Grind smooth the crack and the edges of the perforation in the north channel web and strengthen the channel.
Leaf Truss Vertical	1N-2N	Grind smooth or drill a hole at the end of the crack and install a bolt with nut and washer.
Leaf Truss Diagonal	8S-9S	Inspection with Magnetic Particle Testing at locations of known cracking, and grind cracks.
	9S-10S	Remove sign support angle, grind out crack in top of southeast flange and perform Magnetic Particle Testing.
Tower Truss Members	15N-17N, 15S-17S	Drill drainage holes in members at nodes 15N and 15S respectively to prevent the accumulation of water inside the members.
	18S-19S	Grind smooth the crack and the perimeter of the perforation in the south channel and reinforce the channel.
	15S-18S	Grind smooth the crack and the perimeter of the perforation in the south channel and reinforce the channel.
Main Trunnion Connections	15N/16N, 15S/16S	Grind smooth the suspected crack and the perimeter of the perforation in the vertical gusset plates and install slip-critical bolted plates where possible.

ELEMENT	MEMBER	DETAILS
Counterweight Truss Members	21N-27N	Reinforce the cracked bottom interior angle at 27N.
	26N-26S	Drill drainage holes in member to prevent the accumulation of water inside the member.
	21S-27N	Modify the repair detail at 27N to address the connection of the lower angle to the gusset plate.

The following additional repairs are also recommended for this timeframe:

- Approach Guide Rails: Modify the northeast, northwest, and southwest approach guide rails to meet current MTO standards and TAC requirements. In the interim the damaged 7th and 8th posts from the west end of the southwest guiderail should be replaced.
- Roadway Railings: Modify the anchorage of the post at the east end of the south roadway railing, install a chain or similar railing between the sidewalk and roadway above the main trunnion, and replace the missing bolts from the thrie-beam splices.

Priority Code B (1 to 3 Years):

- Mechanical Platform and Housing: Repair the underside of the mechanical housing slab. Repair the area of section loss in the southeast angled brace bottom flange.
- Marine Structures: Walers exhibiting severe checks or splits should be replaced. Replace missing nuts in the southeast fender wall and tighten loose bolts. Tighten or replace the corroded and loose cables on the south dolphin. Secure the loose safety line posts at the north end of the southwest marine structure and replace the wooden post near the north end with a steel post. The pile clusters of the southwest fender wall should be replaced as they show little to no structural strength.
- Catwalks and Stairs: Repair the perforated support members below catwalk 21N-21S, the split and/or cracked railing posts of catwalks 17N-17S and 21-27, and the cracked welded railing connections of 22N-22S. The split and/or cracked railing posts of stairs 15S-17S, 17N-21N, and 17S-21S should be repaired or replaced.
- Abutment Bearings / Live Load Supports: Replace the bent and severely corroded northwest anchor bolt of the south bearing.
- Curb and Sidewalk: Modify the anchorage of the south timber curb at the west end and replace the missing nuts on the bolts securing the sidewalk planks at the roadway, the nuts missing from the bolts on the north curb, and the missing anchor at the east end of the north curb. Planks with severe end splitting and end checks should be replaced.
- Concrete Counterweight: It is recommended that a major rehabilitation of the counterweight is carried out within the next two years. It is our understanding that a study is currently being carried out (by others) to determine the condition of the concrete towards the centre of the counterweight, and to identify the most practical and feasible rehabilitation method and extent.
- Structural Steel Coating System: Carry out structural steel coating touch-up repairs to arrest active corrosion and further deterioration of the steel members and connections.
- Floor Beams: Install bolts with nuts and washers in the 18 holes at the midspan of FB0.
- Deck Grating, Sills, and Stringers: Replace the steel deck grating and sills. The stringers should also be replaced if further cracking at the copes occurs following the modification work in 2021.

- **Structural Steel Repairs:** The following steel repairs are recommended within 1 to 3 years:

ELEMENT	MEMBER	DETAILS
Leaf Truss Bottom Chord	14S-16S	Replace the 13 deteriorated rivets in the south channel connection to 16S with bolts.
	14N-16N	Strengthen perforated inboard (south) channel web near 16N (as part of the Main Trunnion Rehabilitation project)
Tower Truss	18N-19N	Carry out repairs at 19N to the severe section loss of the channel flanges and the perforated batten plates and replace deteriorated rivets with bolts.
Tower Truss Sway Bracing	20N-20S, 21N-21S	Repair the angles with severe pitting and the perforated batten plates at node 20N and replace the 11 deteriorated rivet heads with bolts.
Tower Truss Connections	15N, 15S	Repair the severe pitting and perforations in the gusset plates and replace the deteriorated rivets with bolts at roadway level as part of the upcoming Main Trunnion Rehabilitation project.
	18N	Repair the section loss and perforation in the gusset plates along the top flanges of 15N-18N and 18N-19N.
	19N	Repair the perforations and pitting in the gusset plates at interface with 19N-20N and 18N-19N and replace deteriorated rivet heads with bolts.
Main Trunnion Connections	15N/16N, 15S/16S	Strengthen the Main Trunnion connections as necessary during the planned rehabilitation project.

<u>Priority Code C (3 to 5 Years):</u>

- **Concrete Repairs:** Carry out repairs to the deteriorated concrete of the following elements:
  - **Wingwalls:** The 10mm wide vertical crack in the southeast wingwall, and the very severe spall at the east end of the southwest wingwall at the interface with the abutment wall.
  - **Bearing Seats**: The area of severe scaling on the west bearing seat north of the truss, the shallow area of disintegration at the south end, and the three spalls. The east bearing seat requires repairs to the spalled area at the northeast corner.
  - **Ballast Walls**: The wide diagonal and vertical cracks and the holes at the bottom of the east ballast wall.
  - **Abutment Walls:** The wide crack at the southeast end of the east abutment, and the large triangular void at the sheet pile/rip-rap interface at the south side of the west abutment.
- **Structural Steel Repairs:** The following steel repairs are recommended within 3 to 5 years:

ELEMENT	MEMBER	DETAILS
Leaf Truss Vertical	1-2; 5-6; 9-10; 13-14	Reinforce the members with the same detail as 13N-14N and 13S-14S to prevent cracking at the web discontinuity location.
Leaf Truss Sway Bracing	5S-5N	Repair the damaged and deformed bottom angle above the westbound lane.
Tower Truss	19S-20S	Replace the 6 deteriorated rivets at 19S with bolts.

- **Operating Pinion Struts:** The exposed sections of struts 17N and 17S inside the mechanical housing should be cleaned and coated to arrest the moderate to severe active corrosion noted.

In addition to the upcoming Structural Steel Repairs contract (R.097736.002) that it is to be carried out in early 2021, it is understanding that PSPC intends to combine the rehabilitation of the Main Trunnion connections (and connecting truss members) and the concrete counterweight into a single design and construction package, with construction anticipated in late 2021 to early 2022.

The traffic staging required to complete the replacement of the deck grating, sills, and (possibly) the stringers will undoubtedly cause major delays to vehicular traffic, and therefore to minimize disruption as much as possible it may make sense to wait until the Third Crossing is open (currently scheduled for late 2022). The 2010 *Engineering Assets Long Term Planning and Options Engineering and Site Analysis* for the Causeway by Opus International Consultants (Canada) Ltd. indicates that while the new crossing will not "eliminate the need for the LaSalle Crossing and would only somewhat mitigate congestion, given the strong orientation of the trips to and from downtown Kingston and CFB Kingston" it would at least provide an alternative route for some vehicles during construction.

To further reduce disruption to bridge users it is recommended that with the exception of the repairs to the Main Trunnions and concrete counterweight, the repairs identified above within the Priority B and Priority C timelines are combined into a single major rehabilitation in 2023.

Table 8: Class 'D' Cost Estimate (Structural)

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	QTY	UNIT COST	ITEM COST	COST CONTINGENCY		CONSTRUCTION COST	ENGINEERING		IN-HOUSE COST		RISK		TOTAL COST
1	Inspecting & Scaling Mechanical House Soffit	M	1	$4,000	$4,000	15%	$600	$4,600	10%	$460	15%	$690.00	10%	$460	$7,000
2	Reinstall Low Clearance Sign on East Portal Frame (1S-1N)	U	1	$3,000	$3,000	15%	$450	$3,450	10%	$345	15%	$518	10%	$345	$5,000
3	Health & Safety Review of Platforms, Catwalks, Stairs, Ladders	S	1	$15,000	$15,000	15%	$2,250	$17,250	0%	$0	25%	$4,313	10%	$1,725	$24,000
4	Monitoring of Roadway Floor Beams	S	1	$2,500	$2,500	15%	$375	$2,875	0%	$0	25%	$719	10%	$288	$4,000
5	Measure & Monitor Deformation of 12N-13N	S	1	$2,500	$2,500	15%	$375	$2,875	0%	$0	25%	$719	10%	$288	$4,000
6	Measure & Monitor Deformation of 14S-16S	S	1	$2,000	$2,000	15%	$300	$2,300	0%	$0	25%	$575	10%	$230	$4,000
7	Fatigue Inspections	S	1	$60,000	$60,000	15%	$9,000	$69,000	0%	$0	25%	$17,250	20%	$13,800	$101,000
8	*2021 Structural Steel Repairs Contract*	A													
8.1	Traffic Control		1	$60,000	$60,000										
8.2	Mobilization/Demobilization		1	$50,000	$50,000										
8.3	Access to Work Area		1	$160,000	$160,000										
8.4	Environmental Protection		1	$40,000	$40,000										
8.5	Steel Deck Grating Repairs		1	$32,400	$32,400										
8.6	Steel Deck Grating Bearing Bar Repairs (Provisional)		1	$2,500	$2,500										
8.7	Repairs to Sill Bolts and Shims		1	$3,000	$3,000										
8.8	Stinger Repairs		1	$373,000	$373,000										
8.9	Inspection & Grinding of Welds at Floorbeam Ends		72	$500	$36,000										
8.10	Perforation & Crack Repairs in Truss Members (Provisional)		5	$800	$4,000										
8.11	Removal of Tack Welds from Primary Truss Members		10	$300	$3,000										
8.12	0N-2N, 0S-2S, 1N-2N: Grind Perforation, Drill Crack, Install Bolt		3	$800	$2,400										
8.13	1S-3S: Trim Channel Flange, Grind Delaminations/Cracks		1	$3,700	$3,700										
8.14	1S-3S: Channel Reinforcement (Provisional)		1	$10,000	$10,000										
8.15	3S-5S: Reinforce North Channel at Delaminations/Cracks		1	$10,000	$10,000										
8.16	8S-9S: Remove Sign, Grind Crack & Welds, Reinstall Sign		1	$1,200	$1,200										
8.17	9S-10S: Remove Sign, Grind Crack & Welds, Reinstall Sign		1	$1,200	$1,200										
8.18	13N-16N: Magnetic Particle Testing of Damaged Area		1	$1,000	$1,000										
8.19	14S-15S: Grind Cracks & Perforation in Bottom Batten Plate near 15S		1	$1,500	$1,500										
8.20	14S-16S: Grind Cracks & Perforation, Strengthen North Channel at Perforation		1	$7,000	$7,000										
8.21	15N-17N & 15S-17S: Drill Holes at 15N/15S to Drain Water		2	$700	$1,400										
8.22	15S-18S: Grind Crack & Perforation, Strengthen South Channel at Perforation		1	$8,400	$8,400										
8.23	15N/16N, 15S/16S: Grind Crack and Perforation, Strengthen Gusset Plate at Perforation		1	$15,000	$15,000										
8.24	18S-19S: Grind Crack & Perforation, Strengthen South Channel at Perforation		1	$8,400	$8,400										
8.25	21N-27N: Reinforce Cracked Bottom Interior Angle at 27N		1	$11,500	$11,500										
8.26	21S-27N: Repair Bracing Bottom Angle at 27N		1	$10,000	$10,000										
8.27	26N-26S: Drill Drainage Holes in Member		1	$1,000	$1,000										
8.28	Approach Slab Repairs		1	$25,000	$25,000										
8.29	Bridge Balancing		1	$15,000	$15,000										
8.30	Localized Structural Steel Coating Repairs		1	$10,000	$10,000										
8.31	Miscellaneous Mechanical Repairs		1	$21,500	$21,500										
8.32	Replace Steel Armouring Angles at Ballast Walls		2	$15,000	$30,000										
				Sub-Total	$959,100	25%	$239,775	$1,198,875	10%	$119,888	25%	$299,719	20%	$239,775	$1,859,000

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	QTY	UNIT COST	ITEM COST	COST CONTINGENCY		CONSTRUCTION COST	ENGINEERING		IN-HOUSE COST		RISK		TOTAL COST
9	*Guide Rail Modifications*	A													
9.1	Mobilization/Demobilization/Traffic Control		1	$5,000	$5,000										
9.2	Modify Existing Guide Rails		1	$15,000	$15,000										
				Sub-Total	**$20,000**	25%	$5,000	**$25,000**	10%	$2,500	25%	$6,250	20%	$5,000	**$39,000**
10	*Roadway Railing Repairs*	A													
10.1	Mobilization/Demobilization/Traffic Control		1	$2,000	$2,000										
10.2	Modification of South Railing Post Anchor		1	$1,500	$1,500										
10.3	Install Chain above South Trunnion		1	$500	$500										
10.4	Replace Missing Thrie-Beam Bolts		1	$500	$500										
				Sub-Total	**$4,500**	15%	$675	**$5,175**	10%	$518	25%	$1,294	10%	$518	**$8,000**
11	*Counterweight and Main Trunnion Repairs*	B													
11.1	Traffic Control		1	$300,000	$300,000										
11.2	Mobilization/Demobilization		1	$200,000	$200,000										
11.3	Access to Work Area		1	$250,000	$250,000										
11.4	Main Trunnion Repairs		1	$1,500,000	$1,500,000										
11.5	Counterweight Repairs		1	$800,000	$800,000										
				Sub-Total	**$3,050,000**	15%	$457,500	**$3,507,500**	25%	$876,875	20%	$701,500	30%	$1,052,250	**$6,139,000**
12	*Major Rehabilitation*	B													
12.1	Traffic Control		1	$200,000	$200,000										
12.2	Mobilization/Demobilization		1	$50,000	$50,000										
12.3	Access & Environmental Protection		1	$100,000	$100,000										
12.4	Mechanical House Soffit Repairs		1	$40,000	$40,000										
12.5	Marine Structure Repairs		1	$25,000	$25,000										
12.6	Repairs to Stairs & Catwalks		1	$20,000	$20,000										
12.7	Replace South Live Load Support Bolt		1	$1,000	$1,000										
12.8	Curb and Sidewalk Anchor Repairs		1	$3,000	$3,000										
12.9	Structural Steel Coating Repairs		1	$100,000	$100,000										
12.10	Install Bolts in FB0		18	$150	$2,700										
12.1	Replacement of Steel Deck Grating, Sills, and Stingers		1	$2,000,000	$2,000,000										
12.12	Tower Truss and Leaf Truss Structural Steel Repairs		1	$100,000	$100,000										
12.1	Clean & Recoat Operating Pinion Struts in Mech. Room		1	$5,000	$5,000										
12.14	Concrete Repairs (Substructure)		1	$12,000	$12,000										
				Sub-Total	**$2,658,700**	25%	$664,675	**$3,323,375**	15%	$498,506	15%	$498,506	20%	$664,675	**$4,986,000**
						Total Construction Cost		**$8,162,275**						Total Cost	**$13,180,000**

Notes: Cost estimate does not include 13% HST
TOTAL COST is rounded up to the nearest $1000
Costs are in 2021 dollars

12.2 Mechanical Recommendations

The priority codes for the recommended mechanical work are as follows. All the repairs identified *in italics* will be carried out as part of the upcoming 2021 Structural Steel Repairs contract (R.097736.002).

Priority S (Studies/Investigations/Surveys):

- Main Trunnion Bearings: Monitor the contact between the main trunnion bearings and the structure through a range of temperatures over a period of time to determine if contraction of the structure is the cause of this condition (Priority A).
- Span Drive Bearings: Monitor the B3-S, B4-N, B4-S, and B5-N-OB bearings for accelerated wear due to misalignment. It is recommended that clearance measurements be taken on a biennial basis (Priority C).

Priority Code A (Within 1 Year):

- Span Drive Brakes: *Install a plate washer at the northeast mounting bolt nut on the machinery brake. Clean and paint the nearby corrosion.*
- Main Trunnion Bearings: Replace the mounting bolts at the main trunnion bearings that have 100% section loss of the bolt head. Clean and paint the bearings.
- Barrier Gates: Consider providing a barrier gate at the east approach to the bridge.
- Span Drive Bearings: *Clean and paint the corroded area between the B1 bearings cap and base.*
- Span Drive Motors: *Paint the unpainted areas on the underside of both motor mounting.*
- Open Gearing and Operating Strut Guide Assembly: Rehabilitate the south pinion and shaft connection and operating guide assembly.
- Full Open Operating Strut Support: Provide lubrication piping and/or access to enable periodic maintenance to the rollers that support the operating strut when the bridge is in the fully open (i.e. at 84°) position. Rehabilitate the roller assembly if the strut support is to be returned to service. (The bridge is currently limited to an opening angle of 65°, so this is only necessary if the bridge is returned to the full design opening angle of 84°)
- Span Locks: *Clean and paint the areas of corrosion on the motor and enclosed reducer mounting bolts and support. Clean and paint the B3 mounting bolts. Clean and paint the shaft between bearing B3 and B4. Clean and paint both adjustable arms for position indication. Clean and paint both front and rear guides east mounting bolts and undersides. Spot clean and paint the cross-shaft bearings. Replace the south receiver mounting bolts and re-align receiver as necessary.*
- Live Load Supports: *Shim the live load supports to provide full bearing at both supports with the bridge seated.*
- Live Load Supports: Clean and paint the areas of corrosion on the underside of the strike plates and the top of the supports.
- Buffers: *Remove the buffers*.
- Warning Gates: *Clean and paint corroded areas at the arms and housing of the warning gates.* Adjust gate arms to provide proper position in raised and lowered positions.
- Bridge Balancing: *Balance the bridge following the 2021 steel repairs.*

Priority Code B (1 to 3 Years):

- Span Drive Open Gearing: Continue to monitor the D and E gearset for degradation on the teeth.
- Open Gearing and Operating Strut Guide Assembly: If the fit between the pinion and pinion shaft and the fits between the pinion, pinion shaft, and keys has not been restored on the south guide assembly, perform an in-depth inspection of the south guide assembly in 2021 (Priority A) and 2026 (Priority D).

Table 9: Class 'D' Cost Estimate (Mechanical)

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	QTY	UNIT COST	ITEM COST	COST CONTINGENCY		CONSTRUCTION COST	ENGINEERING		IN-HOUSE COST		RISK		TOTAL COST
1	*2021 Structural Steel Repairs Contract*	A													
1.1	Install Plate Washer on Machinery Brake NE Mounting Block		1	$500	$500										
1.2	Clean and Paint Corroded Areas at B1 Bearings		2	$500	$1,000										
1.3	Clean and Paint Underside of Span Drive Motors		2	$1,000	$2,000										
1.4	Clean and Paint Corroded Areas Around Span Locks		1	$10,000	$10,000										
1.5	Remove Buffers		2	$8,000	$16,000										
1.6	Clean and Paint Warning Gates		4	$1,000	$4,000										
				Sub-Total	$33,500	15%	$5,025	$38,525	40%	$15,410	25%	$9,631	20%	$7,705	$72,000
2	Clean and Paint Main Trunnion Bearings	A	2	$1,000	$2,000	15%	$300	$2,300	10%	$230	25%	$575	10%	$230	$4,000
3	Clean and Paint Live Load Supports	A	2	$1,500	$3,000	15%	$450	$3,450	10%	$345	25%	$862.50	10%	$345	$6,000
4	Monitor Main Trunnion Bearing Contact	S-A	1	$30,000	$30,000	15%	$4,500	$34,500	0%	$0	25%	$8,625	10%	$3,450	$47,000
5	Replace Main Trunnion Bearing Mounting Bolts	A	2	$20,000	$40,000	25%	$10,000	$50,000	40%	$20,000	25%	$12,500	20%	$10,000	$93,000
6	Install Barrier Gate at East Approach	A	1	$100,000	$100,000	25%	$25,000	$125,000	40%	$50,000	25%	$31,250	10%	$12,500	$219,000
7	South Guide Assembly Repair	A	1	$250,000	$250,000	25%	$62,500	$312,500	40%	$125,000	25%	$78,125	30%	$93,750	$610,000
8	Rehabilitate Full Open Operating Strut Support (*only if bridge opening increased to 84 °*)	A	2	$100,000	$200,000	25%	$50,000	$250,000	40%	$100,000	25%	$62,500	20%	$50,000	$463,000
9	Replace South Span Lock Receiver Mounting Bolts	A	1	$3,000	$3,000	15%	$450	$3,450	40%	$1,380	25%	$863	20%	$690	$7,000
10	Adjust Warning Gate Arm Positioning	A	4	$1,000	$4,000	15%	$600	$4,600	10%	$460	25%	$1,150	10%	$460	$7,000
11	Perform In-Depth Inspection of South Guide Assembly (*only if repair not performed*)	A	1	$90,000	$90,000	15%	$13,500	$103,500	40%	$41,400	25%	$25,875	30%	$31,050	$202,000
12	Monitor D and E Gearset	B	1	$2,000	$2,000	15%	$300	$2,300	0%	$0	25%	$575	20%	$460	$4,000
13	Monitor Misaligned Span Drive Bearings	S-C	1	$2,000	$2,000	15%	$300	$2,300	10%	$230	25%	$575	10%	$230	$4,000
						Total Construction Cost		$932,425						Total Cost	$1,738,000

Notes:

Cost estimate does not include 13% HST

TOTAL COST is rounded up to the nearest $1000

Costs are in 2021 dollars

12.3 Electrical Recommendations

The priority codes for the recommended electrical work are as follows. All the repairs identified *in italics* will be carried out as part of an electrical repairs contract scheduled for spring 2021.

Priority S (Studies/Investigations/Surveys):

- *Un-used Submarine Cable: Determine condition of the original un-used submarine cable. If found to be usable arrange as a backup submarine cable for bridge operation (Priority A).*
- Ductor Testing: Carry out low resistance "Ductor" testing every 5 years (Recurring).
- Arc Flash Study: It is recommended that a protective relaying coordination study and an arc flash study be performed for the bridge electrical distribution system this year (Priority A).
- *Bridge Seating: Interrogate the cause of bridge unable to properly seat with single motor operation and provide mechanical or electrical adjustments accordingly (Priority A).*
- Infrared Thermography Testing: Carry out infrared thermography testing for electrical equipment at the bridge as part of routine maintenance.
- Ground Resistance Testing: Ensure integrity of bridge grounding and bonding installation by performing annual ground resistance testing and visual inspections (Recurring).
- *Feeder Cables: Closely monitor the feeder cables for the span lock motor, span lock motor windings, gate 1 feeders and gate 2 feeders, replace as necessary in the long term (Recurring).*

Priority Code A (Within 1 Year):

- *Generator Load Bank: Provide a load bank for the existing standby generator to enable it to be exercised under load without operating the bridge.*
- *Drive Motor Temperature Monitors: Remove the drive motor temperature monitors as they are no longer in use.*
- *Brake Limit Switches: Provide hand released limit switches on the existing machinery brakes and incorporate into the bridge control logic.*
- *Wire Nuts: Replace all wire nuts presently used as splices with permanent and CSA approved splices.*
- *Brake Wire Labels: Properly label all wires inside the motor brake starter/disconnect switch enclosure.*
- *Hand Crank Limit Switch: Provide a hand crank limit switch to prevent electrical operation of the locks with the hand crank inserted.*
- *Span Lock RCLS Covers: Clean, remove corrosion, and apply protective coating on the span lock RCLS covers.*
- *Traffic Gate Indicators: Replace traffic gate indicators on the main control desk with lights whose status can be seen during times of sun glare.*
- *Control Desk Wires: Properly train all wires and properly label any wires with missing tags inside the control desk wiring cabinet.*
- *Toe Span Limit Switch: Relocate the existing toe end plunger type span seated limit switches so it is outside of the high water level area.*
- *Overspeed Trip Function: Integrate the overspeed trip function to the control circuit such that span will be stopped (or E-Stopped) if the motor loses the control of the span.*
- *East Warning Gong: Repair the non-operational east warning gong.*
- *Traffic Gate Enclosure Door Limit Switches: Provide traffic gate enclosure door limit switches and integrate into the gate operating system such that the gate cannot be operated with doors open.*
- *Traffic Gate Hand Crank Limit Switches: Provide traffic gate hand crank limit switches and integrate into the gate operating system such that the gate cannot be operated with the hand crank inserted.*

- ***Traffic Gate Limit Switches:*** *Clean all traffic gate limit switches and provide protective covers over them.*
- ***Traffic Gate Wiring:*** *Perform housekeeping of wiring in the traffic gate enclosures.*
- ***Northwest Traffic Gate:*** *Provide a hand crank handle for the northwest traffic gate.*
- ***Navigation Light:*** *The existing pivoting navigation light provides restricted vision for marine traffic. Add an additional red/green pivoting navigation light at the toe end of the moving structure.*
- ***Outdoor Junction Box Wires:*** *Properly terminate all spare wires and provide label for all wires in the outdoor junction boxes.*
- **Junction Boxes:** Replace the junction box at the bottom of the staircase leading to the machinery space at the northwest corner of the span facing the control house.
- ***Ground Resistance Testing:*** *Ensure the integrity of the bridge grounding and bonding installation by performing ground resistance testing and performing a visual inspection.*
- ***Span Lock Operator and Control Switch:*** *Replace span lock operator and control switch with a device that is compatible with the present span lock operating function.*
- ***Operator's Control Desk:*** *Replace the operator's control desk with a modern desk containing an HMI and logically laid out bridge control devices.*
- ***Relay Controls:*** *Replace existing bridge relay control logic with a modern redundant PLC based system.*

Priority Code B (1 to 3 Years):

- **Thrustor Brakes:** Procure and install purpose made covers for all thrustor brakes in the machinery space.
- **Traffic Barriers:** Add traffic barriers to the bridge in accordance with CHBDC guidelines.
- **Warning Gates:** Replace all warning gates with new gates that are suitable for the environment, provided with necessary safety limit switches, and with gate starters located in the Motor Control Centre.

Priority Code D:

- **Motor Control Centre:** Replace the existing Motor Control Centre with a modern smart MCC.

Table 10: Class 'D' Cost Estimate (Electrical)

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	QTY	UNIT COST	ITEM COST	COST CONTINGENCY		CONSTRUCTION COST	ENGINEERING		IN-HOUSE COST		RISK		TOTAL COST
1	*2021 Control Systems Replacement & Electrical Repairs Contract*	A													
1.1	Provide Load Bank for Existing Standby Generator		1	$24,000	$24,000	25%	$6,000	**$30,000**	20%	$6,000	20%	$6,000	10%	$3,000	**$45,000**
1.2	Remove the Drive Motor Temperature Monitors		1	$1,000	$1,000	15%	$150	**$1,150**	40%	$460	20%	$230	5%	$58	**$2,000**
1.3	Interrogate Bridge Seating Issues		1	$2,500	$2,500	25%	$625	**$3,125**	50%	$1,563	20%	$625	30%	$938	**$7,000**
1.4	Provide Hand-released Limit Switches on Existing Machinery Brakes and Incorporate into Control Logic		1	$2,500	$2,500	50%	$1,250	**$3,750**	40%	$1,500	20%	$750	10%	$375	**$7,000**
1.5	Replace Wire Nuts with Permanent and CSA-approved Splices		1	$5,000	$5,000	45%	$2,250	**$7,250**	10%	$725	20%	$1,450	10%	$725	**$11,000**
1.6	Properly Label all Wires inside Motor Brake Starter/Disconnect Switch Enclosure		1	$2,000	$2,000	20%	$400	**$2,400**	40%	$960	20%	$480	10%	$240	**$5,000**
1.7	Provide a Hand Crank Limit Switch		1	$7,000	$7,000	25%	$1,750	**$8,750**	25%	$2,188	20%	$1,750	10%	$875	**$14,000**
1.8	Clean, Remove Corrosion, Apply Protective Coating on Span Lock RCLS Covers		1	$1,500	$1,500	25%	$375	**$1,875**	10%	$188	20%	$375	10%	$188	**$3,000**
1.9	Closely Monitor Feeder Cables for Span Lock Motor, Span Lock Motor Windings, Gate 1 and Gate 2 Feeders		1	$1,500	$1,500	10%	$150	**$1,650**	10%	$165	20%	$330	10%	$165	**$3,000**
1.10	Replace Traffic Gate Indicators on Main Control Desk		1	$3,000	$3,000	25%	$750	**$3,750**	40%	$1,500	20%	$750	20%	$750	**$7,000**
1.11	Properly Train All Wires and Label Wires with Missing Tags inside Control Desk Wiring Cabinet		1	$1,500	$1,500	20%	$300	**$1,800**	10%	$180	20%	$360	10%	$180	**$3,000**
1.12	Relocate Toe End Span Seated Limit Switches		1	$4,000	$4,000	20%	$800	**$4,800**	50%	$2,400	20%	$960	10%	$480	**$9,000**
1.13	Integrate Overspeed Trip Function to Control Circuit		1	$3,000	$3,000	35%	$1,050	**$4,050**	40%	$1,620	20%	$810	10%	$405	**$7,000**
1.14	Repair East Warning Gong		1	$1,000	$1,000	15%	$150	**$1,150**	25%	$288	20%	$230	10%	$115	**$2,000**
1.15	Provide Traffic Gate Enclosure Door Limit Switches and Integrate into Gate Operating System		4	$2,500	$10,000	25%	$2,500	**$12,500**	40%	$5,000	20%	$2,500	25%	$3,125	**$24,000**
1.16	Provide Traffic Gate Hand Crank Limit Switches and Integrate into Gate Operating System		4	$2,000	$8,000	25%	$2,000	**$10,000**	40%	$4,000	20%	$2,000	25%	$2,500	**$19,000**
1.17	Clean all Traffic Gate Limit Switches and Provide Protective Covers		4	$1,000	$4,000	25%	$1,000	**$5,000**	10%	$500	20%	$1,000	20%	$1,000	**$8,000**
1.18	Perform Housekeeping of Wiring in Traffic Gate Enclosures		4	$1,200	$4,800	20%	$960	**$5,760**	10%	$576	20%	$1,152	15%	$864	**$9,000**
1.19	Provide Hand Crank Handle for Northwest Traffic Gate		1	$800	$800	25%	$200	**$1,000**	10%	$100	20%	$200	0%	$0	**$2,000**
1.20	Add Additional Red/Green Pivoting Navigation Light at Toe End of Leaf Span		2	$7,000	$14,000	25%	$3,500	**$17,500**	20%	$3,500	20%	$3,500	10%	$1,750	**$27,000**
1.21	Properly Terminate all Spare Wires, and Provide Labels for all Wires in Outdoor Junction Boxes		1	$2,000	$2,000	20%	$400	**$2,400**	25%	$600	20%	$480	10%	$240	**$4,000**
1.22	Determine Condition of Original Un-used Submarine Cable		1	$2,500	$2,500	45%	$1,125	**$3,625**	25%	$906	20%	$725	10%	$363	**$6,000**
1.23	Perform Annual Ground Resistance Testing and Visual Inspection		1	$2,000	$2,000	25%	$500	**$2,500**	25%	$625	20%	$500	10%	$250	**$4,000**
1.24	Replace Span Lock Operator and Control Switch		1	$2,000	$2,000	35%	$700	**$2,700**	25%	$675	20%	$540	10%	$270	**$5,000**
1.25	Replace Operator's Control Desk		1	$90,000	$90,000	35%	$31,500	**$121,500**	60%	$72,900	20%	$24,300	10%	$12,150	**$231,000**
1.26	Replace Existing Bridge Relay Control Logic		1	$180,000	$180,000	25%	$45,000	**$225,000**	60%	$135,000	20%	$45,000	10%	$22,500	**$428,000**
				Sub-Total	**$379,600**			**$484,985**							**$892,000**
2	Perform Infrared Thermography Testing	S	1	$4,000	**$4,000**	15%	$600	**$4,600**	0%	$0	25%	$1,150	10%	$460	**$7,000**
3	Perform Annual Ground Resistance Testing and Visual Inspection	S	1	$2,000	**$2,000**	15%	$300	**$2,300**	0%	$0	25%	$575	10%	$230	**$4,000**
4	Carry out Low Resistance "Ductor" Testing every 5 Years	S	1	$3,000	**$3,000**	15%	$450	**$3,450**	0%	$0	25%	$863	10%	$345	**$5,000**
5	Perform Protective Relaying Coordination and Arc Flash Studies	S	1	$70,000	**$70,000**	15%	$10,500	**$80,500**	0%	$0	25%	$20,125	10%	$8,050	**$109,000**
6	Replace Junction Box at Northwest Corner of Span	A	1	$1,000	**$1,000**	15%	$150	**$1,150**	25%	$288	25%	$288	10%	$115	**$2,000**
7	Procure and Install Purpose-made Covers for Thrustor Brakes in Machinery Space	B	3	$4,000	**$12,000**	15%	$1,800	**$13,800**	15%	$2,070	25%	$3,450	10%	$1,380	**$21,000**
8	Replace all Warning Gates	B	4	$80,000	**$320,000**	25%	$80,000	**$400,000**	15%	$60,000	25%	$100,000	20%	$80,000	**$640,000**
9	Add Traffic Barriers to Bridge in ccordance with CHBDC Guidelines	B	2	$100,000	**$200,000**	25%	$50,000	**$250,000**	40%	$100,000	25%	$62,500	20%	$50,000	**$463,000**
10	Replace Motor Control Centre	D	1	$150,000	**$150,000**	15%	$22,500	**$172,500**	40%	$69,000	25%	$43,125	20%	$34,500	**$320,000**
							Total Construction Cost	**$1,413,285**						**Total Cost**	**$2,463,000**

Notes:

Cost estimate does not include 13% HST

TOTAL COST is rounded up to the nearest $1000

Costs are in 2021 dollars

13. 10-Year Management Plan

A 10-year Management Plan for the Bascule Bridge has been developed and is presented in the following tables. The cost management for the structure is presented individually, rather than as an overall strategy for the entire Causeway. The management plan has been developed based on the recommended rehabilitation, maintenance items, and studies for structural, mechanical, and electrical components presented in the preceding sections. The costs include relevant Cost Amplification Factors (Cost Contingency, Engineering Fees, PSPC In-House Costs, and Project Risk) as provided by PSPC, but do not include HST. The costs are presented in 2020 dollars, and an annual inflation rate of 2% has been assumed. Recommendations for structural, mechanical, and electrical components have been presented separately as these are typically performed under separate contracts.

The Class 'D' cost estimates provided in the 10-year Management Plan are at a conceptual level only (i.e. a rough order-of-magnitude estimate used for comparison based on historical costs for similar work) and do not include costs associated with routine maintenance such as maintenance of light fixtures and bulbs, signage, graffiti removal, sweeping and cleaning, and mechanical component lubrication. The items are listed within the time periods considered appropriate due to scheduling and urgency.

The following further studies, investigations, and surveys (Priority S) have been recommended:

Structural

- Carry out a complete Health and Safety review/audit of the stairs and catwalks to identify all locations of potential falling hazards.
- Monitoring of roadway floor beam deformation.
- Monitoring of the mechanical housing soffit for additional delaminations.
- Measuring and monitoring of the deformation of Leaf Truss diagonal member 12N-13N.
- Measuring and monitoring of the deformation of Leaf Truss bottom chord member 14S-16S.
- Ongoing, regular targeted fatigue inspections with Magnetic Particle Testing.

Mechanical

- Monitor the B3-S, B4-N, B4-S, and B5-N-OB span drive bearings for accelerated wear due to misalignment.
- Monitor the contact between the main trunnion bearings and the structure through a range of temperatures over a period of time to determine if contraction of the structure is the cause of this condition.

Electrical

- Determine condition of the original un-used submarine cable. If found to be usable arrange as a backup submarine cable for bridge operation.
- Carry out low resistance "Ductor" testing every 5 years.
- It is recommended that a protective relaying coordination study and an arc flash study be performed for the bridge electrical distribution system this year.
- Interrogate the cause of bridge unable to properly seat with single motor operation and provide mechanical or electrical adjustments accordingly.
- Carry out infrared thermography testing for electrical equipment at the bridge as part of routine maintenance.
- Ensure integrity of bridge grounding and bonding installation by performing annual ground resistance testing and visual inspections.

- Closely monitor the feeder cables for the span lock motor, span lock motor windings, gate 1 feeders and gate 2 feeders, replace as necessary in the long term.

The capital expenditure required to implement the recommendations of these studies, investigations, and surveys is difficult to quantify at this stage, and therefore a cost estimate has not been provided.

In addition to the recommended structural studies and evaluations listed above, Parsons understands that a renewal options analysis study (by others) is currently underway for the Causeway. The 10-Year Management Plan does not incorporate any capital expenditure required to implement the recommendations of the study.

Table 11: 10-Year Structure Management Plan – Structural

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	10-YEAR MANAGEMENT PLAN COSTS (x $1000)[2,3,4]									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capital Costs and Studies												
1	Inspecting & Scaling Mechanical House Soffit	M	7	7								
2	Reinstall Low Clearance Sign on East Portal Frame (1S-1N)	U	5									
3	Health & Safety Review of Platforms, Catwalks, Stairs, Ladders	S	24									
4	Monitoring of Roadway Floor Beams	S	4	4								
5	Measure & Monitor Deformation of 12N-13N	S	4	4								
6	Measure & Monitor Deformation of 14S-16S	S	4	4								
7	Fatigue Inspections	S	101		105		109		114		118	
8	2021 Structural Steel Repairs Contract	A	1,859									
9	Guide Rail Modifications	A	39									
10	Roadway Railing Repairs	A	8									
11	Counterweight and Main Trunnion Repairs	B	877	5,367								
12	Major Rehabilitation	B		508	4,669							
	Yearly Cost		2,932	5,895	4,774	0	109	0	114	0	118	0

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	10-YEAR MANAGEMENT PLAN COSTS (x $1000)[2,3,4]									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Typical Repair and Maintenance[1] and Comprehensive Detailed Inspections												
1	Deck Grating Repairs	M		10								
2	Timber Sidewalk & Curb Repairs	M	4		4		4		5		5	
3	Guide Rail Repairs	M		10				11				
4	Comprehensive Detailed & Underwater Inspections	S	110		140		121		155		131	
	Yearly Cost		114	20	145	0	126	11	160	0	136	0
	Total Yearly Cost		3,046	5,915	4,918	0	235	11	273	0	254	0

Notes:

1. *Typical Repair and Maintenance costs do not include items such as changing of light fixtures and bulbs, signage, graffiti removal, snow removal, pavement markings, flushing debris from structure.*
2. *All costs are rounded to the nearest 1,000, and include an assumed annual inflation rate of 2%.*
3. *All costs shown are in 2021 dollars and are exclusive of HST.*
4. *All costs include relevant Cost Amplification Factors for Cost Contingency, Engineering, PSPC In-House Costs, and Project Risk allowance.*
5. *Costs in 2021 for Counterweight and Main Trunnion Repairs are for Engineering.*
6. *Costs in 2022 for Major Rehabilitation are for Engineering.*

Table 12: 10-Year Structure Management Plan – Mechanical

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	10-YEAR MANAGEMENT PLAN COSTS (x $1000)[1,2,3]									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capital Costs and Studies												
1	Mechanical Repairs (2021 Structural Steel Repairs Contract)	A	72									
2	Clean and Paint Main Trunnion Bearings	A	4									
3	Clean and Paint Live Load Supports	A	6									
4	Monitor Main Trunnion Bearing Contact	S-A	47									
5	Replace Main Trunnion Bearing Mounting Bolts	A	93									
6	Install Barrier Gate at East Approach	A	219									
7	South Guide Assembly Repair	A	610									
8	Rehabilitate Full Open Operating Strut Support (only if bridge opening increased to 84°)	A	463									
9	Replace South Span Lock Receiver Mounting Bolts	A	7	7								
10	Adjust Warning Gate Arm Positioning	A	7	7								
11	Perform In-Depth Inspection of South Guide Assembly (only if repair not performed)	A/D	202					223				
12	Monitor D and E Gearset	B			4							
13	Monitor Misaligned Span Drive Bearings	S-C					4					
	Total Yearly Cost		1,730	14	4	0	4	223	0	0	0	0

Notes:

1. *All costs are rounded to the nearest $1,000, and include an assumed annual inflation rate of 2%.*
2. *All costs shown are in 2021 dollars and are exclusive of HST.*
3. *All costs include relevant Cost Amplification Factors for Cost Contingency, Engineering, PSPC In-House Costs, and Project Risk allowance.*

Table 13: 10-Year Structure Management Plan – Electrical

ITEM NO.	ITEM DESCRIPTION	PRIORITY CODE	10-YEAR MANAGEMENT PLAN COSTS (x $1000)[1,2,3]									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capital Costs and Studies												
1	2021 Control Systems Replacement & Electrical Repairs Contract	A	892									
2	Perform Infrared Thermography Testing	S	7		7		8		8		8	
3	Perform Annual Ground Resistance Testing and Visual Inspection	S	4	4	4	4	4	4	5	5	5	5
4	Carry out Low Resistance "Ductor" Testing every 5 Years	A	5					6				
5	Perform Protective Relaying Coordination and Arc Flash Studies	A	109									
6	Replace Junction Box at Northwest Corner of Span	A	2									
7	Procure and Install Purpose-made Covers for Thrustor Brakes in Machinery Space	B			22							
8	Replace all Warning Gates	B			666							
9	Add Traffic Barriers to Bridge in ccordance with CHBDC Guidelines	B			482							
10	Replace Motor Control Centre	D								368		
	Total Yearly Cost		1,019	4	1,181	4	12	10	12	372	13	5

Notes:

1. *All costs are rounded to the nearest $1,000, and include an assumed annual inflation rate of 2%.*
2. *All costs shown are in 2021 dollars and are exclusive of HST.*
3. *All costs include relevant Cost Amplification Factors for Cost Contingency, Engineering, PSPC In-House Costs, and Project Risk allowance.*

14. Closure

We trust that this report contains sufficient information for your present purposes. If you have any questions regarding this report, please contact us.

Yours truly,

PARSONS INC. (Structural)

LICENSED PROFESSIONAL ENGINEER
P.HARVEY
100157538
May 7, 2021
PROVINCE OF ONTARIO

Prepared by:

Spencer Willows, EIT
Structural Designer

Prepared and Reviewed by:

Peter Harvey, P.Eng.
Project Manager / Structural Engineer

WISS, JANNEY, ELSTNER ASSOCIATES INC. (Mechanical and Electrical)

LICENSED PROFESSIONAL ENGINEER
G.T. REES
100120262
May 20, 2021
PROVINCE OF ONTARIO

Gareth Rees, P.Eng.
Electrical Engineer

LICENSED PROFESSIONAL ENGINEER
J.R.WILLIAMS
100175197
May 20, 2021
PROVINCE OF ONTARIO

John Williams, P.Eng.
Mechanical Engineer

APPENDIX A – FIELD OBSERVATION RECORD FORMS (MCR/PCR FORMS)

PWGSC BRIDGE INSPECTION MANUAL (BIM) FIELD OBSERVATION RECORD FORM

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
Primary Components – Through Truss							
Top Chord	0N-1N	4	5	4	5	Light pitting was noted on lower lattice. Moderate to severe pitting (2-4mm) in bottom flange and severe pitting up to 4mm deep in web at top of member near 1N representing an overall 6% loss of cross-sectional area. Light corrosion and coating failure on south flange. Severe pitting 6 mm deep in south top flange 1.5 m above deck but there is a plate on the inside and hence capacity is not affected. Light to localized medium pitting in the vicinity of the node at 1N. Gouge in member 2.3m above deck caused by impact damage.	C
	1N-3N	6	6	6	6	Light pitting 1mm deep or less in south web was noted in the vicinity of the nodes. Some bent lattices.	D
	3N-5N	6	6	6	6	Light pitting was noted at the nodes. Rust jacking near 5N on the south side.	D
	5N-7N	5	6	5	6	Some bent top lattices. Light impact damage on lattice. Light corrosion between some lattices and bottom flange of member. Light pitting 1mm deep in south web at 5N. Area of 55mmx55mm with coating failure and light corrosion at top of lattice near the center.	D
	7N-9N	6	6	5	6	Localized minor pitting (less than 1mm) of bottom flange near 7N. Pitting 2mm deep at base of interior plate at 9N. Top batten plate bent at 9N. Localized coating loss. Pitting 1-2mm deep at center interior web.	D
	9N-11N	5	6	5	6	Localized pitting 1mm deep in southern top flange.	D
	11N-13N	4	5	4	5	Very severe pitting of diaphragm towards 13N and at base of interior splice. Some bent upper lattices.	C
	13N-16N	5	5	4	5	Member has been reinforced at intersection of 13N-16N and 14N-15N. Light pitting 1mm deep was noted in channels at interface between gusset plates at 16N. Impact damage to the south bottom flange with 3mm crack (which was later ground out). Localized severe pitting was noted in the diaphragm near 13N. Severe section loss in lattices above roadway. Pitting 4mm deep in south face of web at the bottom at 13N. Very severe pitting of the south bottom flange at the connection to the bracing lower gusset plate has resulted in 75% section loss of the flange. Pitting 5mm deep in top of south flange 2m above deck representing an overall 6% loss of cross-sectional area. Pitting 3mm deep in top of north flange near 16N. Active corrosion 3mm deep at the west batten plate. Pitting in the inside faces of the west batten plate. 2 holes without bolts.	B
	0S-1S	5	5	5	5	Up to 50% localized section loss of lattice elements due to 4mm pitting near sidewalk over 3.5m in length. 5mm deep pitting and 40% section loss of rivet heads at bottom plate at 1S. Localized pitting 5mm deep in the bottom flange at 0S. Localized pitting 8 mm deep over 50% of height of north web at guiderail level. 50mm x 25mm pitting 4mm deep in north web below sidewalk representing an overall 3% loss of cross-sectional area of member.	C
	1S-3S	5	5	2	3	Very localized medium to severe pitting was observed in the interior of the inner bottom flange at the interface with the web at 1S (15mm x 300mm) representing an overall 5% loss of cross-sectional area. Minor pitting was noted on top angle. Delamination in steel at the north in the bottom flange near 3S. A total of 9 areas of lamination defects. A 41mm crack and a 30mm crack were detected on the north side of the bottom web. A 3mm crack is propagating from both cracks.	A
	3S-5S	2	4	2	3	Localized pitting 1mm deep in north face of web. Light pitting at base of interior plates near 5S. 80mm lamination defect in south face of north channel with a crack parallel to main stress branching off to the west (left of crack) by an additional 60mm in web of primary tension member. A crack 50mm in length parallel to main stress found on bottom of member at the same location as the lamination defect. A 10mm diagonal crack was detected under the 80mm lamination defect, propagating from the bottom edge into the vertical face.	A
	5S-7S	6	6	6	6	Localized light pitting 1mm deep in web.	D
	7S-9S	6	6	6	6	Localized moderate pitting 2mm deep in web and batten plate on north side, near 9S.	D
	9S-11S	6	6	6	6	Localized light pitting 1mm deep in web.	D
	11S-13S	5	4	5	4	Severe pitting 7mm deep was noted on the bottom transverse plates on inside of channel at 13S along with a complete perforation of end stiffener/diaphragm at 13S. Note plate is 13mm thick. Active corrosion in web (6mm average) and batten (4mm average) at interior of 13S. Pitting 3mm deep in south bottom flange near 13S.	B
	13S-16S	5	5	5	5	Several small perforations and severe section loss noted in bottom batten plate and lower flange of inner channel at 16S. Both webs of the members are severely corroded, perforated and have been reinforced at intersection of 13S-16S and 14S-15S.	C

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
Bottom Chord	0N-2N	5	6	5	6	Half of bottom chord replaced from 0N to mid-bay. Some moderate pitting 2mm deep noted in outer web at west end. Minor pitting noted in bottom lattice. An old weld was noted on the exterior channel at the west end. Some light corrosion. Small perforation near 2N.	D
	2N-4N	5	5	4	5	Moderate pitting and localized section loss in top flanges at east and west gusset plate. Light to moderate pitting on lower lattice and localized light pitting on webs and batten plates at 2N. Five lower lattices are deformed and three have severe section loss. Large number of rivets replaced with bolts. Some paint is chipped on the top flanges. Severe pitting 4mm deep in the bottom channel near 2N with an area of 10mmx5mm.	C
	4N-6N	5	5	5	5	Moderate pitting 2mm deep in horizontal surfaces including top and bottom flanges and bottom lattice and inner face of webs. Some lattices are deformed. Cracks were noted in the coating at the splice plates near 6N. Pitting was noted on interior face of inner and outer gusset plates at 4N and 6N.	D
	6N-8N	5	5	5	5	Pitting up to 4mm deep in half the width of the bottom flanges around lattice members is typical, representing an overall 5% loss of cross-sectional area. A few bottom lattice bars are bent and have light pitting 1mm deep.	D
	8N-10N	5	5	5	5	Pitting on the top flanges at 8N and 10N and severe section loss in three lattices near 8N were noted. Pitting up to 4mm deep in half the width of the bottom flanges around lattice members representing 5% loss of cross-sectional area is typical. Coating is chipped at several locations. Moderate pitting 2-3mm deep of webs of bottom chord noted at gusset plates. Light pitting 1mm deep on bottom lattices.	D
	10N-12N	5	5	5	5	Light to moderate pitting in horizontal surfaces typical at nodes in channel web. Light accumulation of debris on horizontal surfaces at connections. Small areas of coating failure with rust staining on top flange. Light corrosion of bottom splice plate. Severe section loss and pitting in two lower lattices.	D
	12N-14N	5	5	5	5	Light to moderate pitting in horizontal surfaces and web of channels. Moderate to severe pitting of interior face of bottom chord at 12N. Moderate pitting and light corrosion noted on adjacent batten plates at 12N. Moderate pitting also noted in lattice at gusset plate. Light to moderate corrosion of lower fasteners near 12N.	D
	14N-15N	5	5	4	5	Light to moderate pitting in interior surfaces of web plates. Severe localized pitting in exterior of south web noted at 15N and where 2 members (14N-16N and 14N-15N) intersect at 14N. Light corrosion was also noted in these areas and along interior web. Pack rust and active corrosion between web plate and channel web. Localized areas of peeling coating on south face. Localized 1mm pitting in exterior surface of exterior channel. Severe pitting 5mm deep in top batten plate near 16N.	C
	14N-16N	5	3	4	3	Light pitting 1mm deep noted in exterior face of outer web. Localized moderate to severe pitting and rust jacking noted on the inner face of the south channel web at the interface with 14N-15N. Perforation noted in inner web near 16N. The coating is missing over a large section of the outer face of the inner channel at 16N with light corrosion present. Severe pitting 3mm deep at the gusset plate near 16N on the interior of the south and north web.	A
	0S-2S	5	5	4	5	Half of bottom chord replaced from 0S to mid-bay. Light accumulation of debris on horizontal surfaces at connections. Severe localized section loss and a small perforation with an area of $10mm^2$ at base of exterior gusset plate and exterior web of channel at joint 2S at connection with sidewalk floor beam. Severe pitting 7mm deep with an area of 9mmx10mm in the top flange next to joint 2S.	B
	2S-4S	5	5	5	5	Light pitting 1mm deep in horizontal surfaces, lower flanges at 4S and exterior face of outer web. Pitting up to 13mm high and 2mm deep in interior face of channel web along length of member.	D
	4S-6S	5	5	4	5	Severe localized section loss at base of exterior web at joints 4S and 6S at connection with sidewalk floor beam. Light pitting 1mm deep in horizontal surfaces and lower lattices. Severe pitting 4-6mm deep near joint 6S with and area of 15mmx5mm. Two bent lower lattices.	C
	6S-8S	5	5	4	5	Severe pitting 4mm deep in horizontal surfaces along the bottom of the channel near joint 6S with an area of 1800mmx50mm. 3 bottom lattice elements have been bent. Some of the rivets were replaced with bolts in this member.	C
	8S-10S	5	5	5	5	Severe pitting 6mm deep with an area of 100mmx80mm was noted in horizontal surfaces, typically around upper lattice connections. Two lattices have severe section loss near 10S.	C
	10S-12S	5	5	5	5	Pitting noted in interior faces of batten plates and exterior surface of exterior channel at 10S. Light corrosion was noted at	D

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						several spots on the top of the upper flanges. Rivets in splice have been replaced with bolts. Light corrosion was noted at the interior splice plate at 12S.	
	12S-14S	5	5	5	5	Moderate pitting 2mm deep in horizontal surfaces. Severe pitting in underside of exterior flange at interface with lattice. Moderate pitting noted on inner and outer channel webs on the exterior sides at 12S. Rust jacking between web plate and channel at top of the interior face. Section loss in bottom flange of channel at lattice connections. Severe section loss in seven lower lattices.	C
	14S-15S	4	4	2	4	Large area of very severe pitting of exterior web and edge of bottom flange. Light to moderate pitting noted on most surfaces. Member has been reinforced and rivets have been replaced with bolts. Section loss of rivets noted at 14S. Severe localized section loss and knife-edge corrosion of both bottom flanges over 1m near node 14 where 2 members (14S-16S and 14S-15S) cross representing from 50 to 100% loss of flange thickness. Light to moderate active corrosion was also noted in these areas, in the interior web near 15S, and at top plate near 16S. Small perforation noted in north channel web and 2 perforations in bottom of batten plate near 15S; multiple cracks were noted around the perforations in the bottom batten plate ranging in length from 3mm to 11mm.	A
	14S-16S	2	3	2	3	All lattices have been replaced with cut-out plate and rivets have been replaced with bolts on the underside of the member. Rivets have been replaced with bolts on inboard gusset plate at 16S. Two perforations in interior channel with a total area of 750 mm^2. 12mm long vertical crack in north channel web perpendicular to main stress propagating from existing perforation. Severe localized pitting noted on inner webs where 14S-16S and 14S-15S intersect. 13 rivets in outboard channel connection to 16S have over 75% section loss of rivet heads. 100% section loss of bottom flange near joint 14S, with an area of 70mmx20mm. Member has deformed near 16S prior to cut-out plate replacement and appears to have further deformed following plate installation. Light pitting 1mm deep in horizontal surfaces. Light corrosion noted along the interior face of the north channel.	S, A
Diagonals	1N-4N	6	6	5	6	Light pitting 1mm deep in lattice and on web at 4N. Some bent lattices near deck level. Coating loss and light corrosion above railing on the inside.	D
	4N-5N	5	6	5	6	Light to medium pitting was noted in the lattice along with deteriorated rivet heads. Scrapes with light corrosion in south channel. Pitting 1mm deep in top flange at lattice.	D
	5N-8N	5	5	5	5	Pitting 2mm deep in top flanges at interface with lattice towards 8N representing an overall 3% loss of cross-sectional area. Some severe pitting 6mm deep in the external face of the inside flanges above the gusset plate at deck level. Some light corrosion developing at the interface between the upper flanges and the lattice. Chips in topcoat of south face of south channel.	D
	8N-9N	5	5	5	5	Pitting in lower lattice and rivet heads. Pitting has caused up to 30% localized cross-sectional loss in lower lattice and rivet heads. Severe pitting 6-7mm deep above gusset plate at deck level on the exterior face of the inside flange. Light corrosion on top lattices.	D
	9N-12N	5	4	5	4	Very severe pitting and section loss was noted in the interior channel web at 12N. Several rivets have been replaced with high strength bolts. North and south channel have been strengthened. Pitting up to 3mm deep in top flange at lattice approximately 1.5m above railing level representing 4% cross-sectional loss. Pitting 1-2mm deep in the top flange at the lattice about 1.5m above railing. A lattice near the upper end is bent.	B
	12N-13N	5	5	5	5	Medium pitting in top and bottom flanges at lattice and lattice itself at roadway level. Member strengthened. Light pitting also noted on inner face of webs. The upper 1.0m of the member and batten plate were noted to be deformed into an S-shape at node 13N. Pitting 3mm deep in underside of bottom lattice above railing level and 2mm deep at the top lattice. Pitting 1-2mm deep in the external web. Localized pitting 2mm deep in inside face of north channel just above repair representing an overall 4% loss of cross-sectional area.	S, D
	1S-4S	5	5	5	5	30% localized cross-sectional loss of top flange thickness at interface with bottom lattice. Minor pitting less than 1mm deep noted at connections. Up to 30% cross-sectional loss in lattice and scrapes in paint.	D
	4S-5S	5	5	5	5	Pitting 3mm deep in top flange at railing level and below. Pitting has caused up to 25% localized section loss of top flange at lattice. Localized coating failures.	D
	5S-8S	5	5	5	5	Pitting in lattice flange. Pitting has caused up to 50% localized section loss of lattice at the base of member. 6 bent lattices	D

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						were observed.	
	8S-9S	5	5	5	5	Pitting 3mm deep has caused up to 30% localized cross-sectional loss in lower lattice and rivet heads. The signboards have been welded to the flanges and gouged the diagonal. Localized light pitting 1mm deep on the inboard angle and bottom batten plate. Two angles installed to strengthen sign support. Some galvanized bolts were noted. Light corrosion and scrapes in member.	D
	9S-12S	5	5	5	5	Pitting has caused up to 70% localized section loss of bottom flange (6mm deep pitting) at base of member. The signboards have been welded to the flanges and gouged the diagonal. Member has been strengthened. Two new plates installed on outside faces of channels. Some galvanized bolts were noted.	D
	12S-13S	4	5	4	5	Pitting 6mm deep up to 50% localized section loss of bottom flange and web at connections to lattice in the lower section of member. Localized severe section loss of outer web noted below sidewalk level. Section loss noted in rivet heads on bottom flange. Buckling of the upper batten plate at node 13S was noted. 3 bent lattice and localized coating failures.	B
Verticals	1N-2N	2	5	2	5	Member has been extensively reinforced and numerous rivets have been replaced with high strength bolts. Impact damage observed to inner and outer flanges with some localized coating failure. Localized light corrosion jacking was noted between the flange of the exterior angle and plate. Southwest flange bent above bottom chord level. Several tack welds. 3mm crack at flame cut hole at the bottom chord. Pitting 1mm deep in the inner flange at mid-height.	A
	3N-4N	5	5	5	5	Severe localized section loss due to pitting of gusset plates, lattice and flanges at 4N including perforations in inboard flanges at top of gusset plate. The most severe section loss was observed in lower lattice. Member has been reinforced with steel angles bolted to both inner and outer flanges. Light fixture has been welded to the interior flanges of the member. Scrapes at road level. Localized chips and light corrosion. Light pitting 1mm deep in lattice.	C
	5N-6N	5	5	5	5	Lattice has been replaced with cut-out steel plate and rivets have been replaced with bolts. Severe localized section loss noted in lower batten plate at the connection to the inner and outer webs. Two small perforations noted. Several tack welds. Localized section loss about 1mm deep at sway bracing and at mid-height.	C
	7N-8N	5	5	5	5	Small hole cut in inner angle at 8N. Localized pitting noted in lower batten plate and lattice below roadway. Some light 1mm deep localized pitting of lattice at connection to angles noted at bottom and middle of member. A perforation was noted in the S/W flange at 8N. Southwest flange bent at deck level with localized light corrosion. Severe pitting 4-6mm deep with localized light corrosion in the exterior face of the inside flange at deck level above the gusset plate. 20% section loss in 1 rivet	C
	9N-10N	5	5	5	5	Lattice in member replaced with cut-out steel plate and many of the rivets have been replaced with bolts. Pitting and section loss were observed in the lower batten plate. Impact damage to the member has bent a portion of southeast flange above railing. Light corrosion on member. There is a flame-cut hole in the northwest and northeast flange, but no cracks were found. A bent flange beneath the northwest hole was observed in the 2018 CDI but was not observed during the current inspection.	C
	11N-12N	4	5	4	5	Severe localized section loss and perforations at 12N through entire length of original inner flanges. Inner and outer flanges heavily reinforced in lower half of member with additional angles, after it appears the member buckled. Welding of the roadway lighting has gouged the flange of one angle. Active corrosion of the original flanges at 12N. Pitting 4mm deep in lattices at railing level representing 15% loss of cross-sectional area. Light corrosion on member.	B
	13N-14N	4	6	4	5	Suspected fatigue cracks noted in both south side angles between the original batten plate and the new batten plate above 14N were repaired in the winter of 2017/2018 and strengthening of 14S and members at location of cracks was carried out. Lattice in member has been replaced with cut-out plate and ladder is provided for inspection of pin at 13N. Bolts used in repaired section are too short.	C
	1S-2S	5	6	5	6	Hole noted on outer flange of member. Impact damage to the member on the roadside was observed. The northwest flange is slightly bent at the impact location, the coating is damaged at the impact location, and light corrosion is present. Lattice has been replaced with cut-out steel plate and some rivets have been replaced with bolts.	C
	3S-4S	4	4	4	4	Pitting up to 6mm deep of inside flange thickness at sidewalk level representing 70% localized loss of cross-sectional thickness. Section loss also noted in rivet heads. Up to 50% cross-sectional loss of lattice and the underside of the angles. Scrapes and light corrosion on inner angles.	B

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	5S-6S	5	6	5	6	Member generally in good condition. Lattice has been replaced with cut-out plate and some rivets have been replaced with bolts. Northwest flange bent.	D
	7S-8S	5	6	5	6	Member generally in good condition. Light corrosion. Impact damage was noted on southwest angle. Navigation light has been welded to member.	D
	9S-10S	2	5	2	5	Lattice has been replaced with cut-out steel plate and some rivets have been replaced with bolts. Some localized corrosion noted at coating damage. Localized light pitting 1mm deep was observed on inboard surface of member. Sign previously welded to member has been reconnected with bolts. Light welded on south side. 3mm crack found at weld removal location.	B
	11S-12S	4	5	4	5	Pitting 6mm deep in flange representing up to 80% localized cross-sectional loss of flange thickness below sidewalk level. Member has been partially reinforced. Localized light corrosion.	C
	13S-14S	5	5	5	5	Using magnetic particle testing, no crack was detected in the flame-cut hole in the northeast angle at the bolt approximately 2m above the roadway. Lattice has been replaced with cut-out steel plate and some rivets have been replaced with bolts.	D
Primary Components – Connections							
Main Trunnion Connections	15N/16N	3	4	2	2	Connection includes all gusset plates at 15N and 16N and member 15N-16N but does not include the trunnion collar plates at 15N or the vertical gusset plates connecting Tower Truss member 15N-17N. 15mm vertical crack propagating from large perforation at base of inside vertical gusset plate between end of 14N-16N and FB16 at 16N parallel to shear stress affecting capacity. The remaining thickness of the 12.7mm plate above the perforation was determined by UT to be as low as 3mm. The south face of the interior vertical gusset plate has 3mm pitting at the interface with the top flange of 14N-16N. 6 rivet heads at the base of the interior face of the south vertical gusset plate between end of 14N-16N and FB16 at 16N have very severe section loss. The interior plate of the south triangular member behind FB16 has three perforations and 10 to 12mm section loss adjacent to the connecting clip angles. Severe pitting was also noted in the clip angles. There is a large perforation in the west transverse built-up plate (only visible when the bridge is in the open position) between the vertical gusset plates. Very severe section loss in the rivet heads and angle at the base of the exterior face of the south plate. The configuration of the connection traps water inside tower truss member 15N-18N and as a result the head end of the four bolts that secure the trunnion bearing housing to the structure has 100% section loss due to corrosion. Light corrosion occurring at locations of previous UT measurements due to coating being removed.	A
	15S/16S	3	4	2	2	Connection includes all gusset plates at 15S and 16S and member 15S-16S but does not include the trunnion collar plates at 15S or the vertical gusset plates connecting Tower Truss member 15S-17S. There are perforations at the base of the north and south vertical gusset plates between end of 14S-16S and FB16 at 16S. 13 rivet heads at the base of the interior face of the south vertical gusset plate at the end of 14S-16S at 16S have around 75% section loss, as does the base of the gusset plate. The exterior face of the south vertical gusset plate has 6mm pitting (50% section loss) at the interface with the top flange of 14S-16S. The exterior plate of the north triangular member behind FB16 has a large perforation at the base of the original plate. Additional perforations have been repaired by the addition of a welded plate. The upper section of the north (roadside) plate adjacent to the trunnion collar has widespread severe pitting. UT measurements indicate remaining thickness generally between 6.6mm and 9.6mm (original thickness was 12.7mm) with one location (at top of plate next to trunnion collar) of 3.3mm. The north vertical gusset plate has a perforation and a 3mm long crack in the east edge immediately above the north top flange of bottom chord 14S-16S. The north face of the plate has pitting at the interface with 14S-16S with a remaining thickness as low as 5.7mm. The rivets at the base of the north vertical gusset plate at the end of 14S-16S at 16S have been replace with bolts, and there is widespread 2mm pitting in the south face of the plate. The configuration of the connection traps water inside tower truss member 15S-18S and as a result the head end of the four bolts that secure the trunnion bearing housing to the structure has 100% section loss due to corrosion. Light corrosion occurring at locations of UT measurements due to coating being removed.	A
Through Truss Connections	0N	5	6	5	6	Some light corrosion and rust staining were noted at the vertical stiffener plate.	D
	1N	5	6	5	6	Light to medium pitting was noted on the interior surface of gusset plates.	D
	2N	2	2	2	2	The inboard gusset plate has delaminated into two segments above the bottom chord on the west and east sides over the	A

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						full height of the plate. Full-width cracks were identified in 2018 inspection in both the east and west sides of the gusset plate, appear to be stable during current inspection. Vertical batten plate cut to accommodate cables. Light to moderate pitting of gusset plates. Large number of rivets replaced with bolts. Coating is cracking/peeling.	
	3N	5	6	5	6	Gusset plates are in generally good condition. Light pitting 1mm deep was noted on upper surface of bottom gusset plate.	D
	4N	5	5	5	5	Pitting 6mm deep along the top flange of the bottom chord representing an overall 4% loss of cross-sectional area. Light pitting of interior gusset plate. Coating is peeling off/cracking on east side of 4N on the inboard gusset.	D
	5N	6	6	5	6	Gusset plates are in generally good condition. Light pitting 1mm deep near south side. Medium pitting 2-3mm deep in the bottom surface of the top gusset plate. Pitting 2-4mm deep along the inside face at the top chord.	D
	6N	5	5	4	5	Pitting 3mm deep along the top flange of the bottom chord representing an overall 3% loss of cross-sectional area and light rust jacking was noted. Pitting 3-4mm deep with light corrosion occurring in the bottom half of the bottom gusset plate amounting to an area of 810mmx910mm. Pitting 1-2mm deep in exterior gusset plate with peeling of the coating. Pitting 6mm deep in interior vertical gusset plate with an area of 140mmx210mm.	C
	7N	6	6	6	6	Minor pitting 1mm deep in top and bottom of top gusset plates.	D
	8N	5	5	5	5	Pitting 2mm deep in inboard gusset plate representing an overall 2% loss of cross-sectional area noted along the top flange of the bottom chord. Severe pitting 6mm deep along the bottom of the interior gusset plate with an area of 380mmx60mm.	C
	9N	5	5	5	5	Localized light pitting 1mm deep along top edge of gusset plates at top plate. Top of horizontal gusset plate bent at 9N.	D
	10N	5	5	4	4	Localized light pitting 1mm deep was noted along the top flange of the bottom chord. Severe pitting 3mm deep at base of exterior gusset plate representing an overall 3% loss in cross-sectional area and severe pitting 7mm deep along the bottom of the interior gusset plate with an area of 350mmx50mm. Section loss and perforation with corrosion in the bottom horizontal gusset plate with an area of 200mmx10mm.	C
	11N	6	6	6	6	Gusset plates are in generally good condition.	D
	12N	5	5	5	5	Additional plates have been welded to the west side of the inboard and outboard gusset plates. 60% very severe section loss of the inboard gusset was noted at the top flange of the BC. The remnants of a previously welded horizontal plate were observed on the inboard side of the inboard gusset on the east side of 12N. Very severe 50% section loss was observed on the east side of the inboard gusset plate along the floor beam connection. Severe pitting 4mm deep in the interior bottom gusset plate in an area of 400mmx90mm.	C
	13N	6	5	6	5	Inboard gusset plate is slightly bent due to corrosion jacking south side of top gusset plate.	D
	14N	5	5	5	5	Light to moderate pitting 2mm deep in inboard gusset plate along the top flange of the bottom chord. The coating is peeling throughout the node and there is light corrosion.	D
	0S	5	5	5	5	Minor rust staining at bolt threads and cracks in coating.	D
	1S	6	6	5	5	Gusset plates are in generally good condition. Bottom gusset plate has pitting and section loss 2-4mm deep. North channel inside corner has up to 4mm section loss.	D
	2S	5	5	4	5	Severe localized section loss at base of exterior and interior gusset plate and angle at connection with sidewalk floor beam due to the coating peeling allowing some corrosion to occur, and due to pitting 7mm deep in an area of 100mmx70mm.	C
	3S	5	5	5	5	Severe pitting 5mm deep was noted on bottom gusset plate of bracing.	D
	4S	5	5	4	5	Severe pitting 4mm deep at base of exterior gusset plate representing an overall 9% loss of cross-sectional area. Severe pitting in the bottom of the interior gusset plate at the east side (8mm deep), and at the west side (7mm deep), each with an area of about 250mmx50mm. Severe localized section loss in angle at connection with sidewalk floor beam. Pitting 3mm deep was observed in gusset plates along the top flanges of the BC members. Section loss of interior vertical batten plate.	C
	5S	5	5	5	5	Light pitting 1mm deep was noted on top of upper gusset plate close to rivet line. Top horizontal plate bent.	D
	6S	5	5	4	4	Severe localized section loss due to 4mm deep pitting at base of exterior gusset plate and angle at connection with sidewalk floor beam, with the angle having 100% section loss in an area of 90mmx60mm. 50% section loss of 1 rivet head.	C
	7S	5	5	5	5	Light pitting 1mm deep was noted on the top surface of bottom gusset plate brace connection.	D
	8S	5	5	5	5	Severe localized pitting 8mm deep at base of exterior and interior gusset plates representing an overall 6% loss of cross-sectional area. Severe localized pitting 3mm deep in angle at connection with sidewalk floor beam in both the east and west	C

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						side, each with an area of 150mmx70mm, representing an overall 25% loss of cross-sectional area. 3 rivet heads have 50% section loss.	
	9S	6	6	6	6	Gusset plates are in generally good condition.	D
	10S	5	4	4	4	Severe pitting 5mm deep at base of exterior gusset plate representing an overall 10% loss in cross-sectional area and severe pitting 5-7mm deep in angle at connection with sidewalk floor beam representing an overall 40% loss in cross-sectional area. Cracks in coating at connection to floor beam. Severe pitting 8mm deep along bottom of interior vertical gusset plate on the east side, with an area of 140mmx80mm.	B
	11S	5	5	5	5	Light pitting 1mm deep on top surface of bottom gusset plate brace connection.	D
	12S	5	4	4	4	Severe localized pitting 5mm deep representing an overall 10% loss of cross-sectional area at base of exterior gusset plate at connection along base with sidewalk floor beam. Severe pitting 8mm deep along the bottom of the interior gusset plate within an area of 240mmx50mm on the east side, and light pitting on the west side. Severe pitting 6mm deep in the east sidewalk bottom knee plate in an area of 200mmx70mm. Lower gusset plate is collecting debris. 30% section loss of gusset plate at top flange of channels.	B
	13S	5	4	5	4	The outboard gusset plate connection to 12S-13S is bent. Coating failure on gusset plate connecting member 13S-13N. Buckling of the upper batten plate at node 13S was noted. Perforation of end stiffener/diaphragm at 13S. Active corrosion at bottom gusset plate.	B
	14S	3	2	3	2	Severe localized section loss at base of angle and localized severe pitting 7mm deep in exterior gusset plate at connection with sidewalk floor beam. Severe pitting 4mm deep along bottom of interior gusset plate at the east and west. 50% cross-sectional loss was observed along the top flanges of the BC members. Coating failure in exterior gusset plate at recent repair locations.	A
Tower Truss Connections	15N	4	2	4	2	Localized pitting 2-7mm deep representing up to 70% loss of cross-section of plate, four perforations, and 80% loss of rivet head noted in the inboard gusset plate at roadway level. Water is trapped inside the connection. The short column below 15N (only visible when the bridge is the open position) is in generally good condition. Rubbing on inside of north plate.	A
	17N	6	6	6	6	Gusset plates are in generally good condition.	D
	18N	4	3	4	3	Up to 30% localized section loss of the gusset plate thickness and active corrosion along the top flange of members 15N-18N and 18N-19N with a 5mm perforation noted on the inboard gusset plate.	B
	19N	5	3	5	3	Moderate to localized severe pitting representing 30-70% section loss of the plates noted along the vertical flange of the 19N-20N and along the underside of the bottom flange of 18N-19N. Three perforations in the upper and lower gusset plates. 50-95% section loss of rivet heads typical in bottom plate and at base of gusset plates. Active corrosion at the base of the interior face of the inboard gusset plate. Southwest triangular gusset plate is deformed up to 4mm on both the exterior and interior.	B
	20N	6	6	6	6	Gusset plates are in generally good condition.	D
	15S	5	3	4	2	Severe pitting 7mm deep of the inboard gusset plate with a perforation above 15S-14S, with active corrosion. Pitting above flange 13S-16S. Severe pitting on exterior face on the north side. Multiple rivets (>10) with 50-90% section loss.	A
	17S	6	6	5	5	Moderate pitting 2mm deep in gusset plate along 17S-15S.	D
	18S	4	2	4	2	40% severe section loss in the interior of the gusset plates along the top flange of members 15S-18S and 18S-19S.	A
	19S	5	6	4	5	Some light pitting 1mm deep was observed in the gusset plates. Roadway face of the guest plate has very severe pitting up to 7mm deep with active corrosion. Localized coating failures with active light corrosion.	C
	20S	6	6	5	5	Gusset plates are in generally good condition. Moderate pitting 2-3mm deep and section loss above bottom chord of member 20S-20N.	D
Counterweight Truss Connections	21N	6	6	6	6	Gusset plates are in generally good condition.	D
	22N	6	6	6	6	Gusset plates are in generally good condition.	D
	23N	6	6	6	6	Gusset plates are in generally good condition.	D
	24N	6	6	6	6	Gusset plates are in generally good condition.	D
	25N	6	6	6	6	Gusset plates are in generally good condition.	D

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	26N	6	6	6	6	Gusset plates are in generally good condition.	D
	27N	6	6	6	6	Gusset plates are in generally good condition.	D
	21S	6	6	6	6	Gusset plates are in generally good condition.	D
	22S	6	6	6	6	Gusset plates are in generally good condition.	D
	23S	6	6	6	6	Gusset plates are in generally good condition.	D
	24S	6	6	6	6	Gusset plates are in generally good condition. Light pitting 1mm deep along bottom edge of north exterior gusset plate.	D
	25S	6	6	6	6	Light rust staining and jacking on top plate at west side.	D
	26S	6	6	6	6	No significant defects noted.	D
	27S	6	6	6	6	Gusset plates are in generally good condition.	D
Operating Struts	13N-17N	5	6	5	6	Operating strut has been heavily reinforced and lattice has been replaced with cut-out steel plates. Coating on the top flange and on the web has been damaged extensively by the operation of the bridge. Running and sagging in coating. Pitting up to 2mm deep in inboard web representing less than 1% loss of cross-sectional area.	D
	13S-17S	5	6	5	6	Operating strut has been heavily reinforced and lattice has been replaced with cut-out steel plates. Pitting up to 5mm deep representing less than 1% loss of cross-sectional area was noted in inner plate of member at edges but plate was added to outside face to strengthen member. Coating on the upper flange and on the web have been damaged extensively by the operation of the bridge. Coating along the bottom flange has also been damaged. Runs and sags observed in coating.	D
Primary Components – Tower Truss							
Tower Truss	15N-17N	4	3	4	3	A few lower lattice elements at base of member are bent. Localized severe pitting in flanges of channels at connection to lattice. Water is trapped inside 15N-17N at 15N and as a result there is severe pitting in the interior of the member at the connection and 5 rivet heads inboard and 2 rivet heads outboard exhibit severe to complete section loss. The standing water has also led to 100% section loss of the stiffening angles and stiffener plate at node 15N and the bolt heads from the trunnion. Active corrosion between web plate and northwest angle at base of member. Rust jacking between web plates and light corrosion at several locations. North channel web is bent inward due to rust jacking. Corrosion around hole of bottom stiffener plate. 1 rivet is missing in north channel web.	A
	15N-18N	3	4	3	4	Moderate to very severe pitting of channel flanges occurring at all connection to lattice and generally at the base of web. Severe rusting of channel flanges under lattice at some connections. 1 lattice is bent near 15N. Dirt and debris noted on member. Several areas of localized 10% section loss of bottom flanges. Perforation at mid-span on the inner channel. Light and localized moderate pitting is visible on members near 15N. 4 rivet heads have 90-100% section loss near trunnion.	B
	17N-18N	4	5	4	5	Severe localized 4mm pitting in south angles at 17N gusset with rust jacking, and in north angle. Localized pitting 4mm deep representing an overall 15% loss of cross-sectional area in west interior angle near base of member. Rust jacking towards base. Open bolt holes at south, though no component to connect to.	C
	17N-19N	4	5	4	5	Pitting noted at lower connection. Up to 7-8mm localized section loss of inner vertical components at gusset and some sagging of paint. Active corrosion of top flanges at 19N gusset plates. Localized moderate pitting 2-3mm in the exterior flange at 19N.	C
	17N-21N	5	6	5	6	Bottom outside flange bent near node 17N. 3 holes cut in north bottom flange near node 17N.	D
	18N-19N	3	4	2	3	Localized moderate to severe pitting of channels and rivet heads at 19N. Severe pitting 4mm deep throughout interior north web at 18N. Localized severe pitting 4mm deep generally occurs throughout flanges, webs, and lattices. Dirt and debris noted on member. Several areas of localized 10% section loss of bottom flanges. Severe pitting 6mm deep throughout bottom flanges. Perforations in upper and lower batten plates at node 19N and in the inner channel at mid-span. 20 rivets with 50-100% section loss at 19N. Severe pitting 6mm deep throughout bottom flanges and interior north channel, 75mm up from bottom of south channel at 19N. 2 bent lattices.	A
	19N-20N	5	5	5	5	Up to 95% section loss of some rivet heads at the base of the member at 19N. Severe localized section loss of web plate at base. Impact damage to roadside east and west flanges. Active corrosion between web and southwest angle. Deformations in northeast and northwest flanges at machinery room level. Localized corrosion 2-3mm on the web, flanges near lower batten plate, and angles below lower batten plate.	C

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	20N-21N	5	6	5	6	Outer east and west flanges are bent.	D
	15S-17S	4	3	3	3	The lower connection at 15S traps water inside 15S-17S causing severe pitting in the interior of the members and many of the rivet heads exhibit severe section loss. Up to 20% localized section loss of the underside of the bottom flange at lattices near base of member. Active corrosion jacking noted on inner and outer web plates near base of member, and at north web plate. Pitting in interior of south web plate above gusset plate at 15S. Perforations and section loss in the interior web near the active corrosion occurring at 15S. Center and lower batten plates have severe pitting. Runs and sagging noted in coating. Several bent lattices.	A
	15S-18S	2	4	2	4	10-30% section loss of top flange of the channels at lattice. Areas of up to 80% localized section loss of bottom flange thickness and up to 70% section loss of rivet heads. Localized active corrosion and pitting of top batten plate at east end. Medium corrosion noted on flanges around bolts in channels at east end localized at one lattice. Active rust jacking on reinforcement plate. There are two 3mm long cracks emanating from a perforation in the south channel, one on the left and the other on the right of the perforation. Active corrosion at the perforation in the south channel. Pitting and active corrosion on inside web of channel at 15S. Moderate pitting 2mm deep on exterior channel.	A
	17S-18S	4	5	4	5	Localized light pitting 1mm deep noted in bottom batten plate. 30% section loss of bottom gusset plates with active rust jacking causing deformation of gusset. Localized light corrosion was also noted. Streetlight welded on to north face of member. 2mm of section loss in the bottom angles and batten plate.	C
	17S-19S	5	5	5	5	Localized light pitting 1mm deep noted in bottom batten plates at the level of the roadway. Minor pitting also noted in angles. Runs and sagging noted in coating. Some corrosion also noted on inner plate also at joints. Knife edge section loss at batten ends on flanges.	D
	17S-21S	5	6	5	6	Minor rust jacking of web plate.	D
	18S-19S	2	4	2	4	Pitting 5mm deep in bottom flange and rivet heads at joint 18S representing an overall 9% loss of cross-sectional area. 10-20% section loss around rivet heads throughout member. 2 rivet heads have up to 50% section loss. Section loss and perforations noted in bottom batten plates. There is a 70mm long crack emanating from three perforations in the south channel. Localized section loss of 2-3mm on top flange.	A
	19S-20S	5	5	4	5	70% localized section loss of 6 rivet heads at base of member. Impact damage to the west flange was noted approximately 2 meters above road level. Localized light pitting 1mm deep of a vertical batten plate. Some corrosion also noted on inner plate at joints. Active medium corrosion on north web plate. Moderate pitting 2-3mm deep on north angles.	C
	20S-21S	6	6	6	6	Runs noted in coating.	D
Operating Pinion Struts	17N	5	5	5	5	Moderate to severe corrosion noted on the exposed sections of the strut inside the mechanical housing. Severe pitting and section loss are present outside the housing but here the truss has been cleaned and coated and exhibits no ongoing corrosion. Upper stiffeners are bent.	C
	17S	5	5	5	5	Moderate to severe corrosion noted on the exposed sections of the strut inside the mechanical housing. Severe pitting and section loss are present outside the housing but here the truss has been cleaned and coated and exhibits no ongoing corrosion. Upper stiffeners are bent.	C
Primary Components – Counterweight Truss & Link							
Counterweight Truss Members	21N-22N	5	5	4	4	Localized severe pitting 2mm deep in north and south bottom angles at first stiffener representing 15% loss of cross-sectional area of angles. Localized severe pitting 3mm deep in batten plate at this location representing 3% loss of cross-sectional area with severe section loss of four rivet heads. Some light pitting 1mm deep noted on batten plates. Some minor running and sagging in coating. Outstanding leg of lower angle in interior stiffener plate has corroded away. Localized area of pitting 2-7mm deep with a perforation above the lowest rivet in the lower batten plate on the south side.	B
	22N-23N	5	5	5	5	3 top lacings slightly bent. Light pitting 1mm deep in plates. East bottom batten plate has severe pitting along its edges, a small perforation and appears to be holding water. Light corrosion at areas of coating loss from abrasion at northern upper angles.	C
	23N-24N	5	6	5	6	Light 2mm pitting in angles and plates at connections. Cracks in coating of lower east batten plate. Coating on top flanges is flaking and failing.	D

PWGSC BRIDGE INSPECTION MANUAL (BIM) FIELD OBSERVATION RECORD FORM

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	24N-25N	5	5	5	5	5% section loss in angles and plates at connections. The lower south angle has been poorly trimmed 8mm to fit through the connection. Trim has left jagged cut. Cracks in coating at lattice to flange connections (active corrosion).	D
	25N-26N	5	5	5	5	5% section loss in angles and plates at connections. Cracking in coating at lattice and batten plate connection with active corrosion and rust staining. Lower north flange is bent at 26N with coating damage, appearing to be caused by an impact occurring during the operation of the bridge.	D
	26N-27N	5	4	5	4	100% section loss of southern bottom flange at bracing connection (Comment from 2017 CDI report and not seen during current inspection.)	D
	21N-27N	2	4	2	4	Very localized area of pitting at west end at base of interior web and bottom flange representing 20% section loss of angle thickness with severe section loss of a rivet head at this location. Crack confirmed over full width of outstanding leg of lower interior angle at 27N; no change in crack length since previous report.	S, A
	21N-23N	5	6	5	6	Light localized pitting 1mm deep of batten plate at catwalk. Bent lacing on bottom west side.	D
	21N-24N	5	6	5	6	Light pitting noted at 21N. Minor runs and sags in paint.	D
	21N-25N	6	6	6	6	Some minor pitting of batten plate noted at 21N. Minor runs and sags in paint.	D
	25N-27N	5	6	5	6	Localized pitting (5%) at base of member at gusset plate and batten plates. Bent angle at gusset.	D
	21S-22S	5	5	5	5	Pitting 2mm deep representing 15% loss of cross-sectional area in bottom angles at first stiffener. Some light pitting 1mm deep noted on batten plates. Some minor running and sagging in coating. Active rust jacking at lower stiffener at upper lattice.	D
	22S-23S	5	6	5	6	Light to moderate pitting an average of 1-2mm in lower east batten plate along web plates. Moderate pitting an average of 2mm in the underside of the upper east batten plate along web plates.	D
	23S-24S	5	5	5	5	Average of 1mm section loss amounting to 5-10%, over horizontal leg in bottom angles at gusset plates and web at inside stiffeners. Light pitting 1mm deep in batten plates.	C
	24S-25S	5	5	5	5	Average of 1mm section loss amounting to 5-10%, over horizontal leg in bottom angles at gusset plates and web at inside stiffeners. Light pitting 1mm deep in batten plates. Upper and lower south flanges have been previously trimmed leaving short transitions.	C
	25S-26S	5	6	5	6	Light pitting 1mm deep on batten plates. Bent gusset at 25S sway brace gusset plate.	D
	26S-27S	5	6	5	6	Light pitting 1mm deep on batten plates. Concrete surrounding parts of member.	D
	21S-27S	5	5	5	5	Localized severe pitting up to 12mm deep representing an overall 50% loss of cross-sectional area at very end of vertical and horizontal flanges of bottom interior angle at west end; 40% section loss of last rivet head. Light pitting 1mm deep noted in batten plates. Rust jacking of west top batten plate.	S, C
	21S-23S	6	6	6	6	Member generally in good condition.	D
	21S-24S	6	6	6	6	Minor pitting in upper east plate. Sagging noted in paint.	D
	21S-25S	6	6	6	6	Minor pitting along south angle.	D
	25S-27S	5	6	5	6	Light pitting 1mm deep in end of south-west flange thickness at base of member.	D
Counterweight Links	13N-22N	5	6	5	6	Pitting and section loss at connections at intersection with lattice angles. Up to 15% section loss in lower angles, rust jacking on bottom gusset plates and debris on gusset plates.	D
	13S-22S	5	6	5	6	Localized 15% section loss at vertical lattice near the top of the member. Deformation in gusset plate from sway braces was observed over 5mm±.	D
Primary Components – Floor System							
Roadway Floor Beams	FB0	6	5	6	5	Coating has been touched up in a few locations but is now flaking along bottom flange. Floor beam is generally in good condition. Localized light corrosion was noted at the center of the floor beam. 18 holes without bolts drilled in member at midspan.	D
	FB2	6	6	6	6	Minor runs and sags on web. Light pitting 1mm deep was noted on east face of the web at 2N.	D
	FB4	6	6	6	6	Accumulation of debris on bottom flanges. Floor beam generally in good condition.	D
	FB6	6	6	6	6	Accumulation of debris on bottom flanges. Floor beam generally in good condition. Rust jacking on bottom flange next to 6N.	D

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	FB8	6	5	5	5	Extensive running and sagging of coating noted on underside of girder. Local deformations in floor beam web up to 16mm were observed at each stringer connection to floor beam, causing a gap between Stringer E and top flange of FB8.	S, C
	FB10	6	5	6	5	Local deformations in floor beam web up to 16mm were observed.	S, C
	FB12	6	5	6	5	Localized areas of coating failure on west side of web. Local deformations in floor beam web up to 16mm were observed.	S, C
	FB14	6	5	6	5	Local deformations in floor beam web up to 16mm were observed.	S, C
	FB16	6	6	6	6	Accumulation of debris on bottom flanges. Floor beam generally in good condition.	D
Sidewalk Floor Beams	0	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss up to 4mm deep with an area of 150mmx10mm.	C
	2	5	5	5	5	Localized severe pitting 5mm deep and section loss of bottom flange and web at connection to south truss on east face with an area of 20mmx10mm. Severe section loss of rivet heads in this area as well. Coating loss of bottom flange.	C
	4	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of rivet heads in this area as well.	C
	6	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of rivet heads in this area as well.	C
	8	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of rivet heads in this area as well.	C
	10	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of 50% of 3 rivet heads in this area as well. Exterior stringer has two loose bolts in sidewalk connection.	C
	12	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of rivet heads in this area as well.	C
	14	5	5	5	5	Localized moderate pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of rivet heads in this area as well.	C
	16	5	5	5	5	Localized severe pitting and section loss of bottom flange and web at connection to south truss. Severe section loss of rivet heads in this area as well.	C
Stringers FB0-FB2	A (South)	2	5	2	5	1mm crack was noted at the eastern end top cope. The crack has not progressed since the 2018 inspection.	B
	B	2	4	2	4	A 15mm crack was noted at the eastern end bottom cope. Flaking coating on north side.	A
	C	5	6	5	6	A crack was noted in the coating at the top and bottom cope but does not extend into the steel. Flaking coating on north side.	D
	D	5	6	5	6	A crack was noted in the coating at the bottom cope but does not extend into the steel.	D
	E	1	4	1	4	A 15mm notch/crack in the steel was noted at the eastern end bottom cope. The crack has not progressed since the 2018 inspection. Flaking coating on both sides and on cantilever stringers on east side of FB0. Coating peeled off at some areas.	A
	F	2	5	2	5	A 3mm notch/crack in the coating and steel was noted at the eastern end bottom cope. The crack has not progressed since the 2018 inspection.	A
	G	6	6	6	6	Member generally in good condition. Flaking coating in some areas.	D
	H	6	6	6	6	Member generally in good condition. Flaking coating in some areas.	D
	I (North)	6	6	6	6	Member generally in good condition. Flaking coating in some areas.	D
Stringers FB2-FB4	A (South)	6	6	6	6	Member generally in good condition.	D
	B	6	6	6	6	Member generally in good condition.	D
	C	6	6	6	6	Member generally in good condition.	D
	D	6	6	6	6	Member generally in good condition.	D
	E	2	5	2	5	A 3mm notch/crack was noted at the bottom cope at both FB2 and FB4. The cracks have not progressed since the 2018 inspection.	B
	F	2	4	2	4	22mm notch/crack at bottom cope was noted at FB2.	A
	G	2	4	2	4	15mm notch/crack at bottom cope was noted at FB2 and 20mm notch/crack at bottom cope at FB4.	A
	H	6	6	6	6	Member generally in good condition.	D

PWGSC BRIDGE INSPECTION MANUAL (BIM) FIELD OBSERVATION RECORD FORM

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	I (North)	2	5	2	5	3mm notch/crack at bottom cope was noted at FB4. The crack has not progressed since the 2018 inspection.	B
Stringers FB4-FB6	A (South)	5	6	5	6	Deformation of top flange near 4S.	D
	B	6	6	6	6	Member generally in good condition.	D
	C	6	6	6	6	Member generally in good condition.	D
	D	6	6	6	6	Member generally in good condition.	D
	E	6	6	6	6	Member generally in good condition.	D
	F	6	6	6	6	Member generally in good condition.	D
	G	6	6	6	6	Member generally in good condition.	D
	H	6	6	6	6	Member generally in good condition.	D
	I (North)	6	6	6	6	Member generally in good condition.	D
Stringers FB6-FB8	A (South)	6	6	6	6	Member generally in good condition.	D
	B	6	6	6	6	Member generally in good condition.	D
	C	6	6	6	6	Member generally in good condition.	D
	D	6	6	6	6	Member generally in good condition.	D
	E	6	6	6	6	Member generally in good condition.	D
	F	2	4	2	4	18mm notch/crack at bottom cope was noted at FB6.	A
	G	2	4	2	4	16mm notch/crack at bottom cope was noted at FB6 and 5mm notch/crack at bottom cope at FB8.	A
	H	2	4	2	4	15mm notch/crack at bottom cope was noted at FB6 and 7mm notch/crack at bottom cope at FB8. The crack has not progressed since the 2018 inspection.	B
	I (North)	6	6	6	6	Member generally in good condition.	D
Stringers FB8-B10	A (South)	6	6	6	6	Member generally in good condition.	D
	B	6	6	6	6	Member generally in good condition. Light corrosion on sill bolts.	D
	C	6	6	6	6	Member generally in good condition. Two loose sill bolts.	D
	D	6	6	6	6	Localized coating failure at loose sill bolts.	D
	E	2	5	2	5	Localized coating failure at loose sill bolts. 5mm notch/crack at bottom cope was noted at FB8 and 8mm notch/crack at top cope at FB10.	B
	F	6	6	6	6	Member generally in good condition.	D
	G	6	6	6	6	Member generally in good condition. Two missing sill bolts.	D
	H	6	6	6	6	Member generally in good condition.	D
	I (North)	6	6	6	6	Member generally in good condition. Bottom flange at west end is bent.	D
Stringers FB10-FB12	A (South)	5	6	5	6	Light corrosion at west connection.	D
	B	6	6	6	6	Member generally in good condition. One loose sill bolt and one missing.	D
	C	6	6	6	6	Member generally in good condition.	D
	D	6	6	6	6	Paint has peeled on bottom flange. One loose sill bolt and one missing.	D
	E	2	4	2	4	25mm notch/crack at bottom cope was noted at FB10.	A
	F	2	4	2	4	10mm notch/crack at top cope was noted at FB12. The crack has not progressed since the 2018 inspection.	B
	G	6	6	2	4	10mm notch/crack at bottom cope at FB12.	A
	H	2	5	2	5	A 3mm notch/crack was noted in the top cope at FB12. The crack has not progressed since the 2018 inspection.	B
	I (North)	2	5	2	5	A 5mm notch/crack at bottom cope was noted at FB10. The crack has not progressed since the 2018 inspection.	B
Stringers FB12-FB14	A (South)	6	6	6	6	Member generally in good condition.	D
	B	6	6	6	6	Peeling paint on bottom flange.	D
	C	6	6	6	6	Paint has peeled on bottom flange.	D
	D	6	6	6	6	Paint has peeled on bottom flange.	D
	E	2	5	2	5	Peeling paint on member. 3mm crack at top cope was noted at FB12. The crack has not progressed since the 2018	B

PWGSC BRIDGE INSPECTION MANUAL (BIM) FIELD OBSERVATION RECORD FORM

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						inspection.	
	F	2	4	2	4	10mm notch/crack at bottom cope was noted at FB12. The crack has not progressed since the 2018 inspection.	B
	G	2	5	2	5	5mm notch/crack at bottom cope was noted at FB12.	B
	H	5	6	5	6	Member generally in good condition. Peeling paint on member.	D
	I (North)	6	6	6	6	Member generally in good condition.	D
Stringers FB14-FB16	A (South)	6	6	6	6	Member generally in good condition.	D
	B	6	6	6	6	Member generally in good condition.	D
	C	6	6	6	6	Member generally in good condition. Sill bolts are loose. There is a gap between sill and stringer.	D
	D	2	4	2	4	19mm notch/crack at bottom cope was noted at FB14. Moderate pitting 3mm deep in supporting knee angle in an area of 300mmx150mm.	A
	E	2	4	2	4	Majority of sill bolts are loose on south side. 20mm notch/crack at bottom cope and 25mm notch/crack at top cope was noted at FB14. Moderate pitting 3mm deep in supporting knee angle in an area of 300mmx150mm with a perforation with an area of 15mm^2.	A
	F	2	4	2	4	Majority (14) of bolts missing along north side of stringer. The bolts connecting the sills are loose, and the sills are not in contact with stringer. The top flange at this location appears to have been worn down by approximately 1mm. 12mm notch/crack at bottom cope and 10mm notch/crack at top cope was noted at FB14.	A
	G	2	4	2	4	20mm notch/crack at bottom cope and 10mm notch/crack at top cope was noted at FB14. 15mm notch/crack at bottom cope and 3mm notch/crack at top cope was noted at FB16. The cracks have not progressed since the 2018 inspection.	A
	H	2	4	2	4	7mm notch/crack at bottom cope was noted at FB14. 15mm notch/crack at bottom cope and 15mm notch/crack at top cope was noted at FB16. The cracks have not progressed since the 2018 inspection.	A
	I (North)	2	4	2	4	14mm notch/crack at bottom cope and 6mm notch/crack at top cope at FB14. 7mm notch/crack at bottom cope and 12mm notch/crack at top cope was noted at FB16.	A
Sills	All	5	4	5	4	The sidewalk ends of some members were noted as being deformed. Several anchor bolts to stringers were noted as missing, loose, or severely corroded and corrosion is typical where the grating has been filled with concrete. There is widespread light corrosion on the top flange where the coating has failed. The sills above stringer F between FB14-FB16 have a 6mm gap between the sills and the stringer. The majority of the sills have permanent dead-load deflection, creating a gap between the sills and deck grating.	B
Primary Components – Other							
Concrete Counterweight and Housing	-	3	4	2	4	All except the north and south faces of the counterweight are covered with what appear to be corrugated metal roofing panels. Damp staining, large areas of light corrosion, stalactites, and impact damage were noted on the panels on the underside of the counterweight. The doors to the two lower chambers on the east side of the counterweight are in poor condition and are difficult to open and close, and the hinges are also in poor condition and loose. The concrete in the two lower chambers exhibits spalls, disintegration, map cracking, efflorescence deposits and wet stains. Sounding of the concrete in the two lower chambers revealed the presence of deep concrete disintegration particularly on the south face of both chambers. Two small perforations were noted adjacent to the repaired sections of the panels below the chamber doors. The sections of the bottom face of the counterweight visible though gaps in the panels exhibits efflorescence deposits, wet staining, and exposed and corroding rebar and wire mesh. The two upper chambers in the top face of the counterweight contain concrete blocks and catch basin lids used as ballast. The concrete in the upper chambers exhibits spalls, disintegration, and wet areas. The hatch covering the north upper chamber has a broken screw on the east side. The steel plates covering the north and south faces are in good condition overall although light pitting occurs throughout, and some localized areas of deep pitting were noted, particularly in the north plate near node 26N. Some nuts on the ends of the tie rods are loose or are missing. Disintegrated concrete has collected between the concrete and the panels, with most of the debris occurring in the northeast corner. The remaining areas had less to slightly less debris, though all areas had some amount of debris. The removal of the accumulated debris was warranted due to the high risk of the material falling onto the roadway below, possibly striking vehicles. The total amount of debris removed is estimated to be about 45 to 70	B

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						kg (100 to 150 lb.).	
Structural Steel Coating on Primary Components	-	5	5	5	5	The entire truss is coated in light green paint. A few areas have been touched up since the structure was re-coated. The coating has experienced some isolated minor damage and in hard to reach and below deck areas some deterioration was observed. See individual member for details.	B
Deck Grating	-	4	3	3	2	Steel grating exhibits light to medium corrosion on vertical surfaces of the bearing and cross bars. Concrete noted in some voids at east end of the deck. Bent bearing and cross bars were observed throughout the grating. Broken bars were observed mostly at the west and east ends with some broken bars occurring in the middle. Cracked bar-to-bar and bar-to-sill welds were noted at several locations. Various locations of bearing and cross bar steel repairs. Grating panels C and D in bay 10-12 were replaced with new galvanized panels but not all bars were welded to the sills, and some welds have cracked. Two groups of cracked longitudinal bars were noted at the intersection of Panels 15-16 A and B and Panels 15-16 C and D. A new armouring angle was recently installed in 2017 on the east end of the deck grating which eliminated the elevation difference between the deck and the east approach armouring. The serrations have been worn away in the wheel tracks, significantly reducing traction.	A
Main Trunnions	15S & 15N	3	4	2	2	There is contact between the moving structure and the fixed structure in the vicinity of the main trunnion bearings during operation of the bridge, creating a wear step in the tower leg and wearing away the heads of the rivets in the area. The contact is at the outboard side at both bearings and may be a result of contraction of the bridge due to temperature. Four mounting bolts at each main trunnion bearing have failed due to corrosion and should be replaced. Active corrosion was noted on the back (west) side of the north and south trunnions. The south (roadway) side of the north trunnion (node 15N) and the north (roadway) side of the south trunnion (node 15S) have localized pitting of up to 3mm in the 31mm-thick collar plates, and up to 50% (node 15N) and 75% (15S) section loss of some rivet heads. The head ends of four of the mounting bolts for the main trunnion bearing have 100% section loss due to corrosion at both the north and south bearings. The north trunnion bearing exhibits minor fretting corrosion, indicating movement at the connection interface. No cracks were detected. Some areas of localized light corrosion on north side of south trunnion (node 15S). See Mechanical section of report for full details. See 2019 deterioration drawings for plate thickness measurements.	S, A
Counterweight Trunnions	21S & 21N	3	4	3	4	The sleeve studs used to secure the bearing sleeves to the structure are not tight at some locations. There is strong evidence that there is at least one broken sleeve stud: the top east stud at the outboard side of the north trunnion. Based on paint removal, it appears that there has been an attempt to tighten them, but that this was unsuccessful. Maintenance personnel have previously indicated that they used a hammer to drive one of the north counterweight bearing studs in while operating the bridge. This is an indication that the stud has sheared. The results of the phased array testing performed during the 2018 CDI indicate corrosion is present on the upper surface of both the north and south shafts. The south counterweight bearing has two missing lube fittings on the inboard side and a leaking fitting on the east most side of both the inboard and outboard sides. At the north counterweight bearing, one lube fitting is missing on the outboard side. See Mechanical section of report for full details. See Brouco report in 2018 Fatigue Inspection and Evaluation report for thickness measurements.	A
Abutments	East	5	6	5	6	The majority of the abutment wall is not visible. Wide crack at southeast corner, near the sheet piles. Spall 500mm^2 in the bearing seat at the northeast corner, near the bearing pedestal. Light areas of disintegration. Minor accumulation of dirt and debris noted on bearing seat. High water level causing bearing seat to be underwater during inspection occurring on August 14-16, 2019; became visible during inspection occurring on October 23-24, 2019. The 2019 underwater inspection revealed erosion of the concrete wall with a height of about 300mm and about 300mm below the water surface. Some separation between the 3rd and 4th steel sheet pile panels from the north was noted, but there is a plate behind the separation, therefore is no cause for concern.	C
	West	5	6	4	6	The majority of the abutment wall is not visible. Minor accumulation of dirt and debris noted on bearing seat. Area of severe scaling on the bearing seat north of the truss along the sheet piles and a shallow area of disintegration at the south end. 3 spalls in the bearing seat, each with an area of about 300mm^2, and 40mm deep. Water pooling on bearing seat evidence of bearing seat being submerged at high water level.	C

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						The 2019 underwater inspection revealed a triangular void with dimensions of 1000x800mm and depth of 300mm at the sheet pile/rip-rap interface at the south end. Some separation of the sheet piles of about 30mm at the southeast corner was also noted.	
Foundations	-	6	6	6	6	Foundations below ground. No visible evidence of instability.	D
Waterway	-	5	5	5	5	590mm clearance from bottom of bottom chord on August 14, 2019. No visible flow obstruction or obstructions which would impede navigation were noted during our inspection. The seated limit switches on the east abutment were found to have water inside which may be a result of high tide and/or storm conditions. Very high water level at time of inspection causing the east abutment to be submerged, and evidence of west bearing seat being submerged at high water level.	D
Secondary Components – Through Truss							
Upper Cross Bracing	1S-3N	6	5	5	6	Light to localized moderate pitting 2mm deep was noted on the lower vertical angle above gusset at the south end of the member at the connection. Light section loss of rivet head. Light pitting 1mm deep at 3N. Light pitting 1mm deep on north batten plate and at center connection. Moderate pitting on vertical angle 2mm deep midway between center and 3N.	D
	1N-3S	6	5	6	6	Light pitting 1mm deep observed on bottom flange of angle near connection and on upper surface of batten plate connecting members.	D
	3S-5N	6	6	5	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep in both flanges at 5N and center gusset plate. Light pitting 2mm deep in lower batten plate. Localized light corrosion and loss of paint on edges of angles.	D
	3N-5S	6	6	5	6	Upper lateral bracing generally in good condition. Pitting 4mm deep in center of cross brace and light pitting 1mm deep on upper surface of lower batten plate and angle.	D
	5S-7N	6	6	5	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate and angle. Moderate pitting 2mm deep in upper surface of lower gusset plate at center.	D
	5N-7S	6	5	5	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate and top surface of bottom horizontal flange near 7S and 5N. Moderate pitting 2mm deep in vertical leg near 5N.	D
	7S-9N	5	5	6	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate. Localized light pitting on bottom flanges of angle near cross connection. Light pitting 1mm deep in top face of center gusset plate.	D
	7N-9S	6	6	6	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate and angle.	D
	9S-11N	6	6	6	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate and bottom flange.	D
	9N-11S	6	6	6	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate and bottom flange of member. Light pitting 1mm deep in both legs of bottom angle at 9N.	D
	11S-13N	6	6	5	6	Upper lateral bracing generally in good condition. Light pitting 1mm deep on upper surface of lower batten plate. Light corrosion jacking between upper batten plate and member. Light section loss of rivet head near 11S. Pitting 2mm deep at center connection of bottom flange and web plate.	D
	11N-13S	6	5	5	6	Upper lateral bracing generally in good condition. Light pitting on upper surface of lower batten plate. Light corrosion jacking between upper batten plate and member. Pitting 2mm deep at center connection of bottom flange and web plate.	D
Lateral Struts	1S-1N	5	5	5	5	Generally, in good condition. Strut located directly adjacent to east portal truss has rust jacking throughout top plate and flange. Light pitting was noted throughout vertical flange. Pitting 2mm deep in lower gusset at east end. Disused welded sign support on the east side.	D
	3S-3N	5	6	5	6	Generally, in good condition. Light 1mm pitting was noted on lattice and on the top surface of bottom angle.	D
	7S-7N	5	6	5	6	Light 1mm pitting was noted on the bottom flange in north section. Loss of 15% of 2 rivet head was observed at connection 7S. Section loss less than 10% of 3 rivets on the north side.	D
	11S-11N	5	6	5	6	Generally, in good condition. Light pitting 1mm deep was noted on top surface of bottom horizontal flanges. Light section loss of rivet head near 11S.	D
Portals	1S-1N	5	5	5	5	Portal truss consists of a single built-up member composed of lattice on 4 sides with steel angles forming the corners. Impact damage was present on lower west angle. Six lattice on the bottom and west side of the truss are bent. Small	D

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						perforation in western angle at 1S. Localized coating loss and light corrosion. Light pitting 1mm deep on top surface of several lattice at west and east connection. Water ponding in lower angle. Very severe section loss of south batten plate and north gusset plate. There is a crack in the weld connecting the vertical clearance sign to the member. Localized light corrosion.	
	13S-13N	5	5	5	5	Portal truss consists of a bottom and top chord and 3 cross braces. Portal truss is generally in good condition with bottom chord and cross bracing exhibiting medium pitting 2mm deep representing an overall 15% loss of cross-sectional area. Small perforations observed near 13S. Light pitting 1mm deep is also typical on top surface of bottom angle. Severe section loss was noted in the bottom gusset plate and south top chord. Localized coating loss and light corrosion. Bent lattice in bottom chord. Lattice severely bent along the top member above south lane. Light rust jacking at connections.	D
Sway Bracing	5S-5N	4	5	4	5	Two moderate impact damages observed in bottom chord of sway bracing above westbound lane causing a global westward deflection. East angle has been significantly deformed (38mm vertically). Deformed top flange of chord at north and south connection. Localized light corrosion and coating failure at impact locations. Light pitting 1mm deep was noted on top surface of horizontal flanges.	C
	9S-9N	5	5	5	5	Minor impact damages observed in bottom flange of sway bracing above the westbound lane. The east angle forming the bottom chord has been deformed (at 2 locations, approximately 20mm). Torsional deformation in top chord at north and south ends (10mm). Light corrosion and local loss of coating at impact locations. Light pitting 1mm deep on top surface of bottom flange and in vertical connection plates.	C
	13N-13S	5	5	5	5	Sway bracing consists of built-up truss spanning between the top chord members 13S-11S and 13N-11N. Local area of perforation ($100mm^2$) was observed at 13S. Light pitting 1mm deep throughout top surface of bottom angle was noted.	C
Secondary Components – Tower Truss							
Tower Truss Sway Bracing	17N-20N	5	5	5	5	Sway bracing consists of a truss spanning between member 17N-21N and 20N-21N. Bent lattice in lower south section of truss near Joint 17N. Localized corrosion jacking between clip and angle and gusset plate at lower east gusset plate. Localized light pitting 1mm deep on batten plates and angles.	D
	17S-20S	5	5	5	5	Sway bracing consists of a truss spanning between member 17S-21S and 20S-21S. Truss is generally in good condition.	D
	20N-20S	4	4	4	4	Sway bracing consists of a truss spanning between member 20N-21N and 20S-21S. Deep pitting 4mm deep and large and small perforations were noted in the lower north and south batten plate and angles representing 40 to 100% loss of cross-sectional area in batten plates and 40% in angles. Several severely deteriorated rivet heads were observed at connections. Pitting up to 3mm deep representing an overall 15% local loss of cross-sectional area was noted in most angles that make up the bracing truss. Pitting 5mm deep representing an overall 20% loss of cross-sectional area was noted in the bottom east angle at 20N and seven rivet heads have almost 100% section loss on both east and west sides. Very severe section loss of four rivet heads on the east side of bottom angle near 20S.	C
	21N-21S	4	4	4	4	Sway bracing consists of a truss span between member 21N-17N and 21S-17S. Lower batten plate at north end on lower chord exhibits severe pitting and perforations. Numerous rivet heads showing greater than 50% section loss were noted. Moderate pitting noted on upper batten of top chords at both ends of chord. The east flange of the northern connection to member 17N-21N has been trimmed to accommodate the mechanical house. Active corrosion of east flange at south bottom connection. Impact damage of top flange of western brace at south end.	C
Secondary Components – Counterweight Truss & Link							
Counterweight Truss Lateral Struts	West 21N-21S (21-27 Plane)	5	5	5	5	The west lateral member spans between 21N-21S just west of joints 21N/S. Lower west and east angles: 20% localized section loss of horizontal and vertical legs thickness over 1000mm at north and south ends; 30% section loss in 5 rivet heads at north end and 5 rivet heads at south end; up to 20% localized section loss of gusset plate thickness typical. Moderate pitting an average of 2mm deep is typical throughout bottom angles, on the horizontal flanges.	D
	East 21N-21S (21-22 Plane)	5	5	5	5	The east lateral member spans between 21N-22N and 21S-22S just east of joint 21S/N. Moderate pitting 2mm deep was noted on the horizontal flanges of the lower angles representing an overall 10% loss of cross-sectional area.	D

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	Center 21N-21S (21–24 Plane)	5	5	5	5	The center lateral strut spans between the bases of 21N-24N and 21S-24S. Plates have been installed on the lower west angles at the ends of the member to reinstate the cross-sectional area lost through the severe pitting and perforations in the angles and rivets at these locations, though they do not connect to the lattice in both planes. Localized areas of coating are beginning to fail on the bolts at the north end. The west lower angle has 2mm deep pitting along the length of the member.	D
	Upper 22N-22S	5	5	5	5	The upper strut is located just west of the joints 22N/S along members 22N-23N and 22S-23S. Light localized pitting 1mm deep representing 10% section loss of east lower flange thickness at ends of upper bracing member. 1 bent lattice member was observed. Repairs have been previously carried out at the lower north and south gusset plate connection.	D
	Lower 22N-22S	4	4	4	4	The lower strut is located just west of joints 22N/S along members 22N-21N and 22S-21S. Light pitting 1mm deep representing 10% localized section loss of lower flange thickness along length of lower bracing member with typical pitting of the angle horizontal flanges. 30% section loss of lower east angle along its entire length with perforations and section loss at the south gusset plate connection. Perforations in southwest batten plate and member end beyond connections.	D
	23N-23S	4	5	4	4	Pitting up to 2mm deep representing 20% localized section loss of bottom flange thickness of west angle at north end of gusset plate connection with active corrosion. Bottom west angle at 23S has active corrosion and perforations resulting in 10mm wide, 38-50mm long section loss at last 3 rivets. Light pitting 1mm deep in bottom and vertical flanges of east lower angle. Localized corrosion staining and severe pitting in lower gusset plates.	D
	24N-24S	5	5	5	5	8 small drainage holes located in flanges. Member strengthened with plate and bolts at south end connections. The coating is in good condition. Severe pitting and section loss in bottom angles at 24S and 24N and perforation of east angle beyond last rivet in vertical angle legs. Localized moderate pitting 200mm wide (E-W), 400mm long (N-S), and average of 2mm deep in bottom gusset plate at west angle.	D
	25N-25S	5	5	5	5	Flanges at north end are bent. Pitting and 15% section loss were noted in the angle at the bottom east on the north end, and bottom east and west in the south end. Coating in good condition.	D
Counterweight Truss Cross Bracing	21S-22N	5	6	5	6	Light localized pitting 1mm deep at connections.	D
	21N-22S	5	6	5	6	Light localized pitting 1mm deep at lower connection.	D
	22S-23N	5	5	5	5	Light pitting 1mm deep in bottom flange typical. Top flange slightly bent at mid-span of north-west section. Localized area of 10% section loss of south-east bottom flange around rivets. 15% localized section loss of south-east gusset plate thickness, but plate has been previously repaired. Localized 2mm pitting with area of 150mmx20mm in the northeast gusset plate at bottom flange	D
	22N-23S	5	5	5	5	Light pitting 1mm deep of the bottom angles is typical. Pitting in bottom gusset plate at 22N along 22N-23N resulting in 10% section loss and localized along 22N-23N bottom flange.	D
	23S-24N	5	5	5	5	A bent lattice and section loss in the gusset at 23S were noted.	D
	23N-24S	5	6	5	5	Rust jacking on south end. Light corrosion at chips in paint. Light pitting less than 1mm deep in center gusset plate and localized 1mm pitting in bottom gusset plate at 23N along bottom flange.	D
	24S-25N	5	5	5	5	Light pitting 1mm deep on middle plate connecting bracing and gusset plate at 24S.	D
	24N-25S	5	5	5	5	20% localized section loss of bottom flange thickness at north-east end at gusset plate.	D
	25S-26N	5	6	5	6	Minor rust jacking at south end gusset plate has bent the gusset plate.	D
	25N-26S	5	6	5	6	Minor rust jacking at end and center gusset plates. Light corrosion on rivets.	D
	21S-27N	5	2	5	2	North-west end: 100% section loss of full width of horizontal lower leg plus many small perforations. Member has been previously strengthened, however, the strengthening has not addressed the connection of the lower angle to the gusset plate. South-east end: an area of 50mmx50mm, 1-2mm deep amounts to 10% localized section loss of lower horizontal leg thickness at lattice.	A
	21N-27S	5	4	5	4	North-east end: 50% section loss of horizontal upper leg thickness over 750mm length; some pitting in horizontal lower leg. South-west end: 50% localized section loss of lower vertical leg thickness, 100mm x 100mm.	C
	21S-24N	6	6	6	6	Minor pitting at connections to plates. Minor runs and sags in coating.	D
	21N-24S	6	6	6	6	Minor runs and sags in coating. Minor pitting on connection plates.	D

PWGSC BRIDGE INSPECTION MANUAL (BIM) FIELD OBSERVATION RECORD FORM

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
Counterweight Link Lateral Bracing	13N-13S	5	6	5	6	Localized pitting 1mm deep was noted at connections.	D
	13.5N-13.5S	5	5	5	5	Localized light pitting noted. 5% section loss of bottom flange thickness along length of member. Debris on north and south lower gusset plates. Top north and south gusset plates are slightly bent.	D
	22N-22S	5	5	5	5	Localized light pitting noted. 5% section loss of bottom flange thickness along length of member.	D
	13S-13.5N	5	6	5	6	Localized pitting 1mm deep was noted at connections.	D
	13N-13.5S	5	6	5	6	Localized pitting 1mm deep was noted at connections.	D
	13.5S-22N	5	6	5	6	Localized pitting 1mm deep was noted at connections.	D
	13.5N-22S	5	6	5	6	Localized pitting 1mm deep was noted at connections.	D
Secondary Components – Deck							
Lower Cross (Bottom Chord) Bracing	0S-2N	6	6	6	6	Member is slightly deformed.	D
	0N-2S	6	6	6	6	Member is slightly deformed.	D
	2S-4N	5	6	5	6	Minor pitting 1mm deep noted on underside of bracing at north end.	D
	2N-4S	5	6	5	6	Minor pitting 1mm deep noted on underside of bracing at north end. Paint coating has failed at centre of span.	D
	4S-6N	5	6	5	6	Minor pitting 1mm deep noted at connections.	D
	4N-6S	5	6	5	6	Minor pitting 1mm deep noted at connections. Pitting 2mm deep on east and north side in gusset plate representing an overall 2% loss of cross-sectional area.	D
	6S-8N	5	6	5	6	Accumulation of debris on bottom flanges. Coating failure with coating cracks, rust staining and corrosion on member and gusset plate at 8N.	D
	6N-8S	5	6	5	6	Accumulation of debris on bottom flanges. Pitting 2mm deep on east and north side in gusset plate representing an overall 2% loss of cross-sectional area.	D
	8S-10N	5	6	5	6	Pitting 2mm deep in gusset plate.	D
	8N-10S	6	6	6	6	No significant defects noted.	D
	10S-12N	5	5	5	5	Light pitting at connections. Rust staining and cracked paint at centre of span.	D
	10N-12S	4	4	4	4	Moderate to severe pitting 4-5mm deep at connections. Rust staining and cracked paint at centre of span and at end connections. Deformation of gusset plate at 10N with light corrosion at connection. Severe deformation of member. Lug angle at 12S is deformed from previous rust jacking and has severe corrosion along the bottom. Delamination of coating.	D
	12S-14N	5	5	5	5	Moderate pitting at connections. Rust staining and cracked paint at centre of span.	D
	12N-14S	5	5	5	5	Moderate pitting 2mm deep at connections. Rust staining, rust jacking, and cracked paint at centre of span and at 14S.	D
	14S-16N	5	6	5	6	Moderate pitting at connections. Coating peeling at underside of connection plate. Debris accumulation at joint 16N.	D
	14N-16S	5	6	5	6	Moderate pitting at connections.	D
Sidewalk Floor Beam Bracing	0S-2S	5	6	5	6	Member is sagging but is in good material condition.	D
	2S-4S	5	6	5	6	Member is sagging but is in good material condition.	D
	4S-6S	5	6	5	6	Member is sagging but is in good material condition.	D
	6S-8S	5	6	5	6	Member is sagging but is in good material condition.	D
	8S-10S	5	6	5	6	Member is sagging but is in good material condition.	D
	10S-12S	5	6	5	6	Member is sagging but is in good material condition.	D
	12S-14S	5	6	5	6	Member is sagging but is in good material condition.	D
	14S-16S	5	6	5	5	Member is sagging but is in good material condition. Additional minor upwards deformation at middle of member.	D
Secondary Components – Other							
Mechanical Platform and Housing	-	4	5	4	5	The mechanical platform supports the drive motors and machinery and consists of structural steel members embedded in a reinforced concrete slab; the housing walls consist of corrugated steel panels; the housing roof consists of steel members overlain by a membrane style flat roof with three access hatches. The limited condition survey performed on the concrete slab revealed the underside of the slab to be generally in fair-to-poor condition. The underside of the concrete slab exhibits light to moderate scaling, light honeycombing, several light to	U, M

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						medium spalls with exposed rebar, 9 clean medium cracks with a total length of 5.0m, and delaminated areas. These delaminated areas are over the traffic lanes and pose a risk to vehicles passing underneath. The top surface of the slab is in good condition with light scaling. The concrete in the extracted cores form the top and underside of the slab were found to be in good condition. The structural steel members have been coated inside with black paint and are generally in good condition overall. There is a hole in the web of the center beam. Very severe corrosion on bottom flanges of northeast and southeast angled braces, and southeast web. 50-70% section loss in southeast angled brace bottom flange. 5mm section loss and active corrosion in top flange of north motor support beam at west end caused by water leaking into housing. Pitting 7mm deep in bottom flange of east girder at second from south catwalk cantilever support. Very severe rust jacking at west end of bottom flange of second from south and north lower beams. Corrugated steel cladding has been coated and is generally in good condition with old perforations noted around steel framing. Flat roof is sheathed with asphaltic membrane. Indication of leakage was noted on the north wall, at the center, and in the northwest corner of the mechanical housing. Two metal trays leading to a bucket were installed inside the mechanical room to catch leaking water. There was a bird's nest with eggs present underneath the floor beams at the south side, visible from inside the mechanical room at the time of the August 14th-16th 2019 inspection. See 2019 Bridge Check's report for more details on the concrete slab.	
Structural Steel Coating on Secondary Components	-	5	5	5	5	The entire truss is coated in light green paint. A few areas have been touched up since the structure was re-coated in 2010. The coating has experienced some isolated minor damage and in hard-to-reach or below-deck areas some localized deterioration was observed. Generally though, the coating is in like new condition over the majority of the bridge. See individual members for details.	B
Joints	-	5	4	5	4	The joints at the ends of the deck are open. On the approaches the top of the ballast wall is exposed, and an armouring angle is provided which protects the leading edge of the ballast wall. A new armouring angle was recently installed on the east end of the deck grating to eliminate the elevation difference between the deck and the east approach armouring. The top of the ballast walls exhibits moderate scaling and wear at the armouring angle and wide cold joints. Over 50% of west joint armouring sounds hollow when sounded. There are spalls in the concrete around the anchors securing the armouring.	A
Railings	Pedestrian	6	6	6	6	Pedestrian railing on the south side of the sidewalk and on southeast and southwest approach sidewalks is a galvanized steel railing consisting of steel HSS section rails and posts and steel mesh. The railings are in good condition with no significant defects noted.	D
	Operator's House	4	4	4	4	The cast iron pipe railings between the Operator's House and the north trunnion repaired in October 2018. East railing had temporary timber hoarding in front of it at time of inspection.	D
	North Roadway	5	4	5	4	North railing consists of thrie beam guide rail with a lattice railing. Guide rail is generally in good condition. Several bolts were observed to be missing from splices in the guide rails. Light corrosion on west end of guide rail and handrail splice at 9-11. The existing barriers do not meet current CHBDC crash-tested requirements (in terms of geometry and direct attachment to the truss) and could subject primary members of the main truss to damage or failure during vehicle collision along the barrier. The top rail is 1.40m above the deck grating and therefore the railings meet the CHBDC minimum height requirements of 1.37m for combination traffic/bicycle barriers.	A
	South Roadway	5	4	5	4	South railing consists of thrie beam guide rail with a lattice railing. Guide rail is generally in good condition. Guiderail at southeast abutment has localized light corrosion. The railing currently leaves a large gap at the trunnion which could allow a pedestrian to fall into the roadway. Several bolts were observed to be missing from splices in the guide rails. Post at east end has been anchored with lag bolts into sidewalk planks. Light corrosion at west end of thrie-beam and throughout east end of diagonal. Coating flaking on handrail. The existing barriers do not meet current CHBDC crash-tested requirements (in terms of geometry and direct attachment to the truss) and could subject primary members of the main truss to damage or failure during vehicle collision along the barrier. The top rail is 1.40m above the deck grating and therefore the railings meet the CHBDC minimum height requirements of 1.37m for combination traffic/bicycle barriers.	A

PWGSC BRIDGE INSPECTION MANUAL (BIM) FIELD OBSERVATION RECORD FORM

PROJECT TITLE & NUMBER: 2019 Comprehensive Detailed Condition Inspection Report - R.090045.001

STRUCTURE: LaSalle Causeway - Bascule Bridge

Note: 2019 observations / comments in blue text.

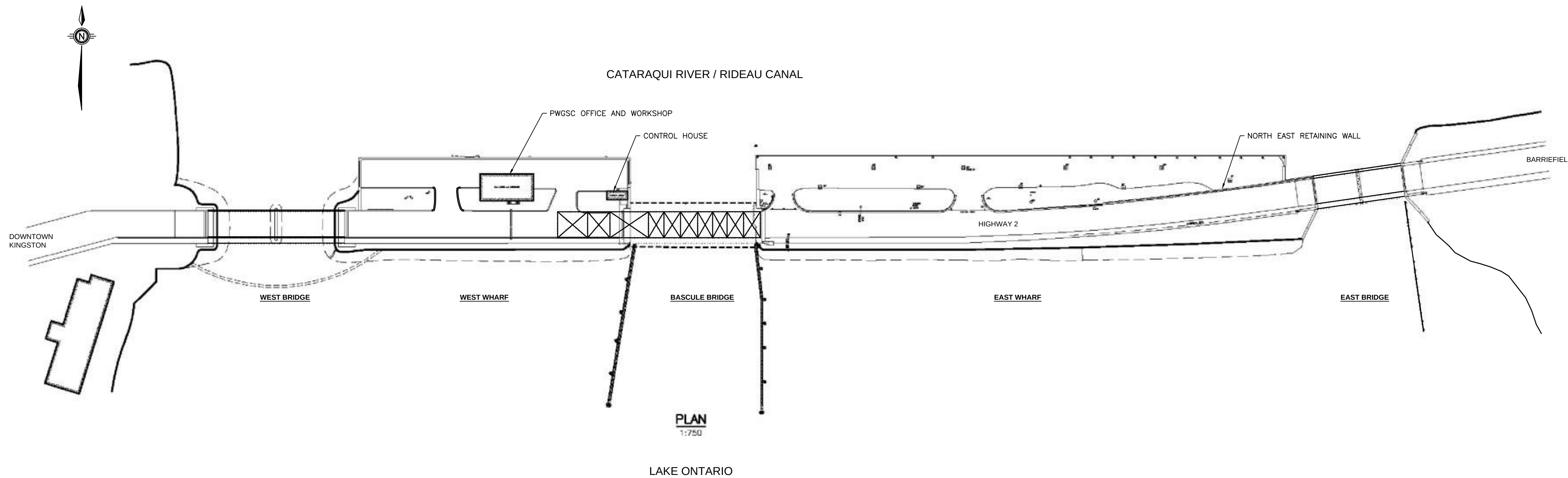
Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
Curb	North	5	5	5	4	Impact damage to east end of timber curb. A few narrow to severe splits and checks were noted. Several bolts used to anchor the curbs were noted to be missing nuts. Curb is not anchored at the east end.	M, B
Sidewalk	South	5	5	5	5	Several light to severe splitting and checks throughout sidewalk timber decking. Sidewalk is only 1.2m wide at truss panel points. Several bolts holding down sidewalk planks on roadway are missing nuts. Previously noted curb section at west end not anchored correctly and some protruding screws at the west end not observed during current inspection. West approach concrete sidewalk has 2 medium transverse cracks. East approach concrete sidewalk has a wide transverse crack.	M, B
Ballast Walls	East	5	6	5	5	Map cracking with damp staining and some efflorescence deposits noted at south end of east ballast wall. Several hairline and narrow vertical cracks also observed. 4 wide diagonal and vertical cracks. 2 holes at the bottom of the wall with a combined area of 1500mm^2.	C
	West	5	6	5	6	Several hairline and narrow diagonal stained cracks noted on ballast wall.	D
Wingwalls	SE	5	6	5	5	Extensive concrete repairs were previously carried out with a new section of wall cast. Extensive light honeycombing was noted and a 10mm wide vertical crack extending into the sidewalk was present at the east end in the original concrete.	C
	SW	5	6	5	6	Extensive concrete repairs were previously carried out with a new section of wall cast. Very severe spall (2m x 2m) at base of wall was observed beyond repaired section at east end at the interface with the abutment. Medium horizontal crack at east end. Vegetation growth below high-water mark.	C
Abutment Bearings / Live Load Supports	East Abutment	4	5	4	5	At the east abutment 2 large pedestal bearings (live load supports) are provided. The northwest anchor bolt of the south bearing is bent and has medium to severe corrosion on the lower section. Light corrosion was noted on the anchor bolts and on some steel plates of the north and south bearings. The bottom of the north bearing is covered in dirt and debris. The north side of the leaf span is not fully seated on the north bearing with a gap of approximately 2mm noted. Under live load the span becomes fully seated. Light corrosion was noted on the bearing plates of the buffer supports.	A
Approach Slabs	East	4	3	4	3	The east end of the approach slab is lower than the west end, suggesting differential settlement has occurred in the past. However, the recent monitoring program indicated no significant ongoing settlement is evident. In addition, two wide transverse cracks near the centre of the slab are at the same location as wide cracks in the curb, sidewalk and southeast wingwall. Settlement was also noted in the adjacent sidewalk and curbs. The interface between the slab and the adjacent asphalt wearing surface has opened up especially on the north side - spalling was noted at the east end of the slab on the north side and the adjacent asphalt is cracked and forming potholes. There is a wide transverse crack at the west end of the slab at the interface with the top of the ballast wall. The slab has widespread abrasion/wear from vehicles, causing the painted shared vehicle/bicycle lane symbol to be wearing off in the westbound lane.	M, A
	West	4	4	4	4	Longitudinal wide transverse cracks noted. The slab has widespread abrasion/wear from vehicles. The wide gap (up to 35mm) at the interface with the ballast wall is only partially sealed with the seal in the westbound lane being 100% deteriorated, and the seal in the eastbound lane being partially deteriorated.	A
Guide Rails	NE	5	1	5	1	Guide rail is not (and cannot be) connected to the structure. Minor impact damage to east end treatment. Slight deformation at the 5th post from east. The spacing of the guide rail posts adjacent to the connection to the structure does not meet current MTO standards.	A
	NW	6	1	5	4	No significant material defects noted. Minor deformation between 2nd and 3rd posts from west. The spacing of the guide rail posts adjacent to the connection to the structure does not meet current MTO standards.	A
	SW	4	1	4	1	Posts are breakaway type which may allow the railing to encroach onto the sidewalk in the event of a vehicle impact. The 7th and 8th posts from the west end have been damaged by vehicular impact and require replacement. Minor damage to steel channel. The spacing of the guide rail posts adjacent to the connection to the structure does not meet current MTO standards.	A
Embankments not Supporting Foundations	SW	6	6	6	6	Embankment generally in good condition with no significant scour or erosion noted.	D
	SE	6	6	6	6	Embankment generally in good condition with no significant scour or erosion noted.	D
Auxiliary Components							
Slope Protection	SW	6	6	6	6	Armour stone is in good condition and performing well.	D

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
	SE	6	6	6	6	Armour stone is in good condition and performing well.	D
Marine Structures (Fender Walls)	SW	5	6	4	4	Multiple piles have splits and rot. One area of splitting, at the north in the bottom waler. The fourth and fifth safety line posts from the north end are loose. Cables around the southern dolphin are corroded and loose. The second safety line post from the north end is wooden rather than steel. All pile clusters have little to no structural strength as they all exhibit rotting, splitting, and crushing. Piles and top walers are in newer condition than the bottom walers. Old, rotten piles just below the waterline at the north end.	B
	SE	5	6	4	4	Most piles have splitting of at least 500mm and rotting. Several walers have splits including a severe split in the top east fender at the north end. Areas of section loss and damage to bottom and top walers. 300mm of rotting at top and splitting typical at all pile clusters. Some nuts are missing or are loose in bottom walers. Some vegetation growth on top of walers. New waler between piles 32 and 36. 8 piles have been jacketed with fibreglass filled with concrete at the waterline and lower. High water level varies on lower quarter of lower waler, causing reduced visibility of some defects at time of inspection.	B
Signs	-	Not Rated	Not Rated	Not Rated	Not Rated	Object Marker signs are provided at all four corners and are in generally good condition. Marine navigation sign attached to vertical member 9S-10S and is in good condition. Clearance sign at west end in good condition. Clearance sign at east end removed and put on timber post at northeast corner during inspection due to cracked welds of the sign bracket causing a safety hazard for vehicles.	U
Utilities	-	Not Rated	Not Rated	Not Rated	Not Rated	The submarine cables were replaced in 2012 and were noted to be in good condition during the 2019 underwater inspection. A number of the original cables are still in place, but it is unclear if they are still in service.	D
Catwalks	17N-17S	5	5	5	5	Catwalk at mechanical room generally in good condition. Some light corrosion on grating. The east c-channel supporting the catwalk outside the mechanical room is supported by the tapered cantilevered members below but only 25mm of the bottom flange is actually supported. Opening next to mechanical house at the south end is a fall hazard. Third post from north end is cracked.	S, C
	21N-21S	5	2	5	2	East support for cantilevered platform on north side has a severe perforation, reducing bolt edge distance to almost zero. Rust jacking on top flange of channel is typical. East and west supports for cantilevered platform on south side have a severe perforation and severed rivet. The west railing has two open sections (leading to ladders) which are a potential falling hazard. The safety cages at the ladders at the ends of the catwalk are too short which is a potential falling hazard. Light corrosion on floor grating.	S, B
	22N-22S	5	6	5	6	East handrail is bent at north end. 2 cracked welds in railing at northeast corner.	S, C
	Counter Weight (21-27)	5	4	5	4	3 posts on the north side of the catwalk have split vertically over half their height. 1 post on the southwest side has split. There is no safety chain or gate at the west end of the catwalk preventing access onto the counterweight roof.	S, B
Stairs	15N-17N	5	6	5	6	Access staircase generally in good condition with local light corrosion on south handrail post at bottom. Note that this member includes stairs from the ground.	S, D
	15S-17S	5	6	5	6	Access staircase generally in good condition. Cracked end post at the southeast. Crack in end post at northeast at bend in top rail.	S, C
	17N-21N	4	5	4	5	Top handrail on north side of north truss is bent. Severe pitting 3mm deep in channels representing an overall 30% loss of cross-sectional area and pitting 3mm deep in supporting angles at steps typical representing an overall 20% loss of cross-sectional area. Cracked weld at top of north rail inclined section and at the northwest rail. Perforation in north support at 17N. Southwest post on platform below 21N is split.	S, B
	17S-21S	5	5	5	5	Light corrosion and split posts on north side and south side at the ladder. Handrail bent at several locations. Severe pitting 3mm deep in channels representing an overall 30% loss of cross-sectional area and pitting 3mm deep in supporting angles at steps typical representing an overall 20% loss of cross-sectional area. Light corrosion on washers on steps typical.	S, B
	21-22	3	4	3	4	Large perforation ($225mm^2$) in north top flange at 3rd step from the top, and in south web at 11th step from bottom and top step. Severe pitting 3mm deep and $4mm^2$ perforation in south channel web at the top step representing an overall 40% loss of cross-sectional area. Pitting 2mm deep in webs at some steps representing an overall 20% loss of cross-sectional	S, B

Note: 2019 observations / comments in blue text.

Element	Member	Previous MCR	Previous PCR	New MCR	New PCR	Comments	Priority Code
						area. Perforations in north and south web at bottom stair across the entire web coincident with very severe section loss and 3-4 mm deep pitting.	
Chain Link Fence	Southwest	6	6	5	6	No significant defects noted. Vegetation is covering fence. Loose barbed wire noted. Some chain links bent and damaged at south end.	D
	Southeast	6	6	6	6	No significant defects noted.	D
	East	6	6	6	6	No significant defects noted.	D
Lighting	North, South	Not Rated	Not Rated	Not Rated	Not Rated	Marine navigation lights are bolted to vertical member 7S-8S and 7N-8N and appear to be in general good material condition. Roadway lights are welded to through truss verticals 3N-4N, 7S-8S, 11N-12N, and 17S-18S and appear to be in general good material condition. A pedestrian light is welded to vertical member 9S-10S and appears to be in good condition.	D

APPENDIX B – GENERAL ARRANGMENT AND DETERIORATION DRAWINGS



PLAN
1:750

Public Services and Procurement Canada
Services publics et Approvisionnement Canada

PARSONS

revision	description	date

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the engineer of all discrepancies.

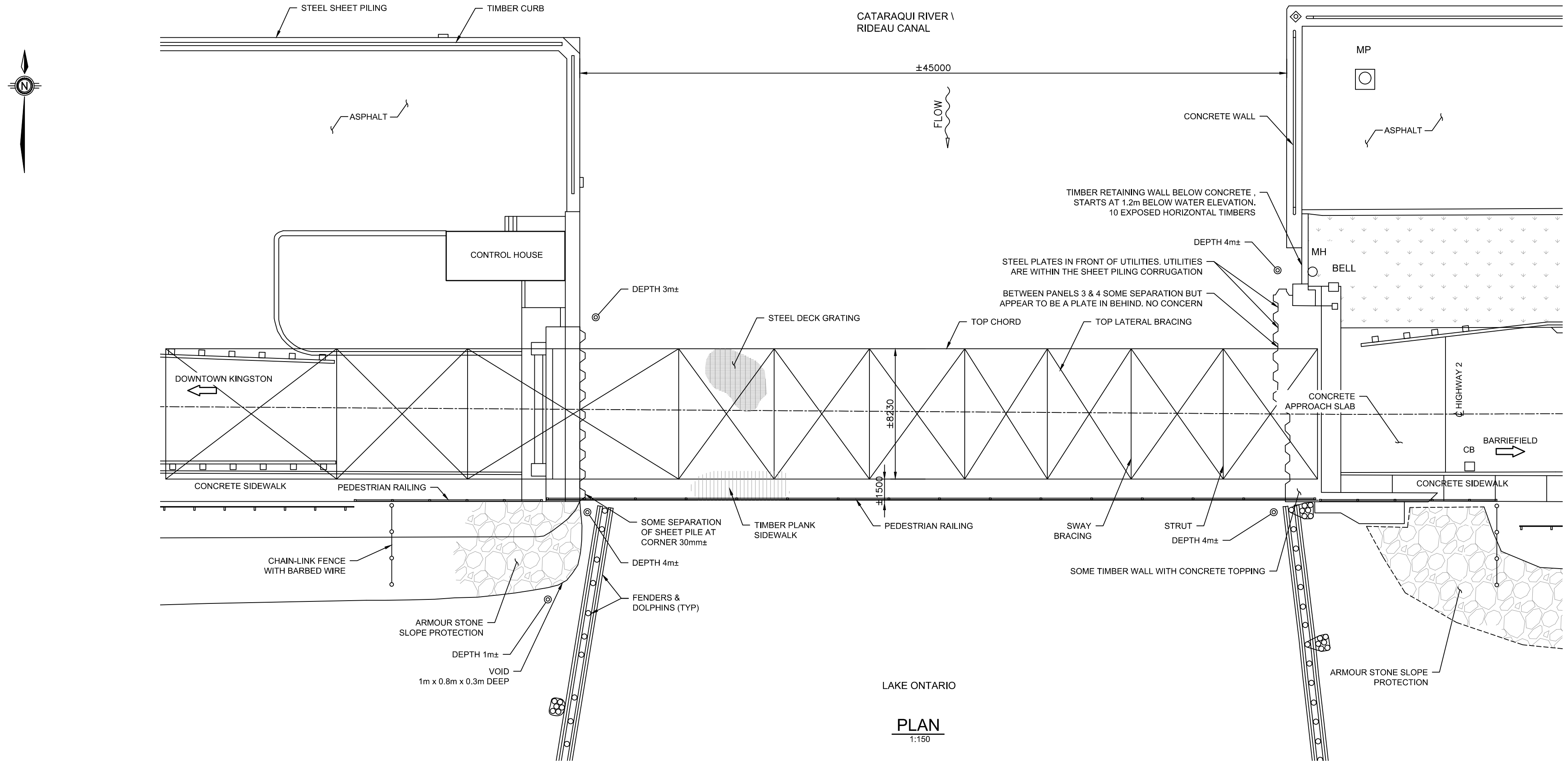
A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LaSALLE CAUSEWAY
BASCULE BRIDGE
2019 COMPREHENSIVE DETAILED INSPECTION
KINGSTON ONTARIO

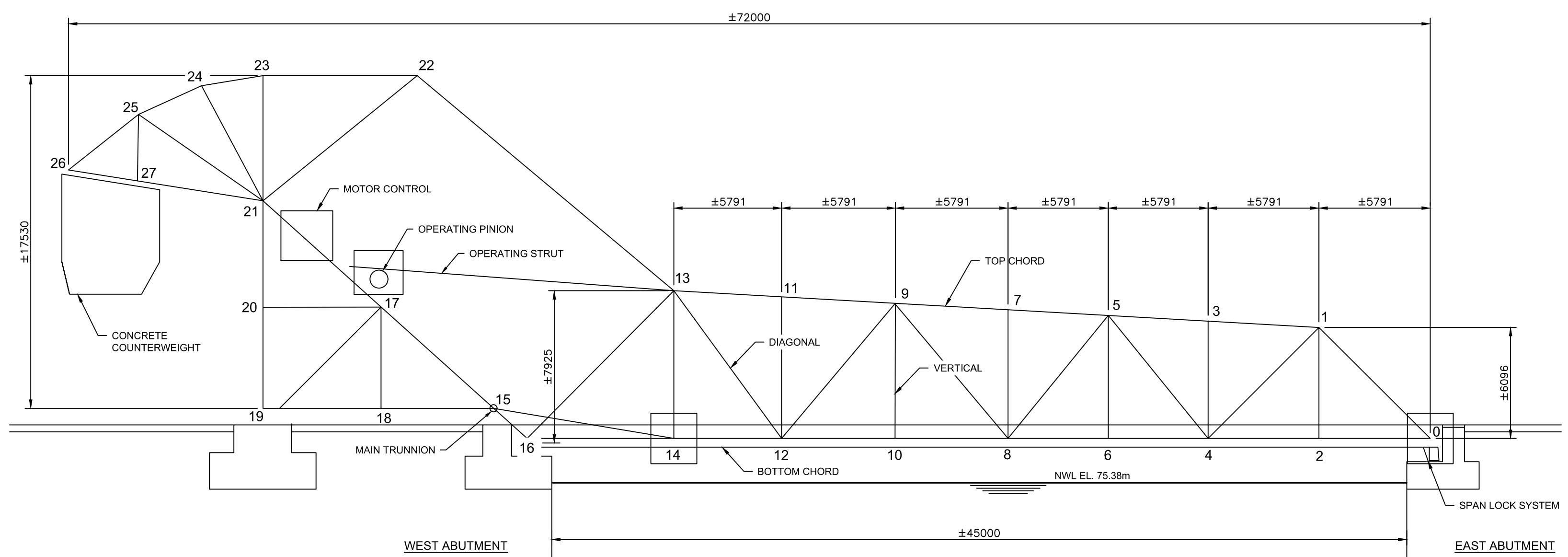
drawing title / titre du dessin
SITE PLAN

drawn by / dessine par: R. DYNKA
designed by / conc par: S. WILLOWS
approved by / approuve par: P. HARVEY
tender / soumission: MATIN SADRZADEH — project manager / administrateur de projets
project date / date du projet: FEBRUARY 2021
project no. / no. du projet: R.090045.001
drawing no. / dessine no.: B01

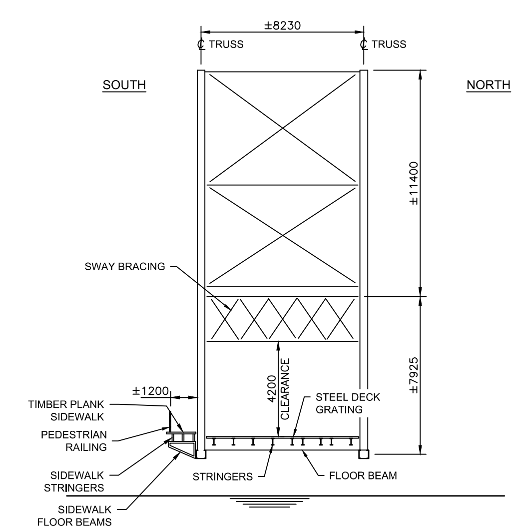
04 11



PLAN
1:150



ELEVATION
1:150



SECTION
1:150

Public Services and Procurement Canada
Services publics et Approvisionnement Canada

PARSONS

revision	description	date

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the engineer of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LaSALLE CAUSEWAY BASCULE BRIDGE
2019 COMPREHENSIVE DETAILED INSPECTION
KINGSTON ONTARIO

drawing title / titre du dessin
GENERAL ARRANGEMENT

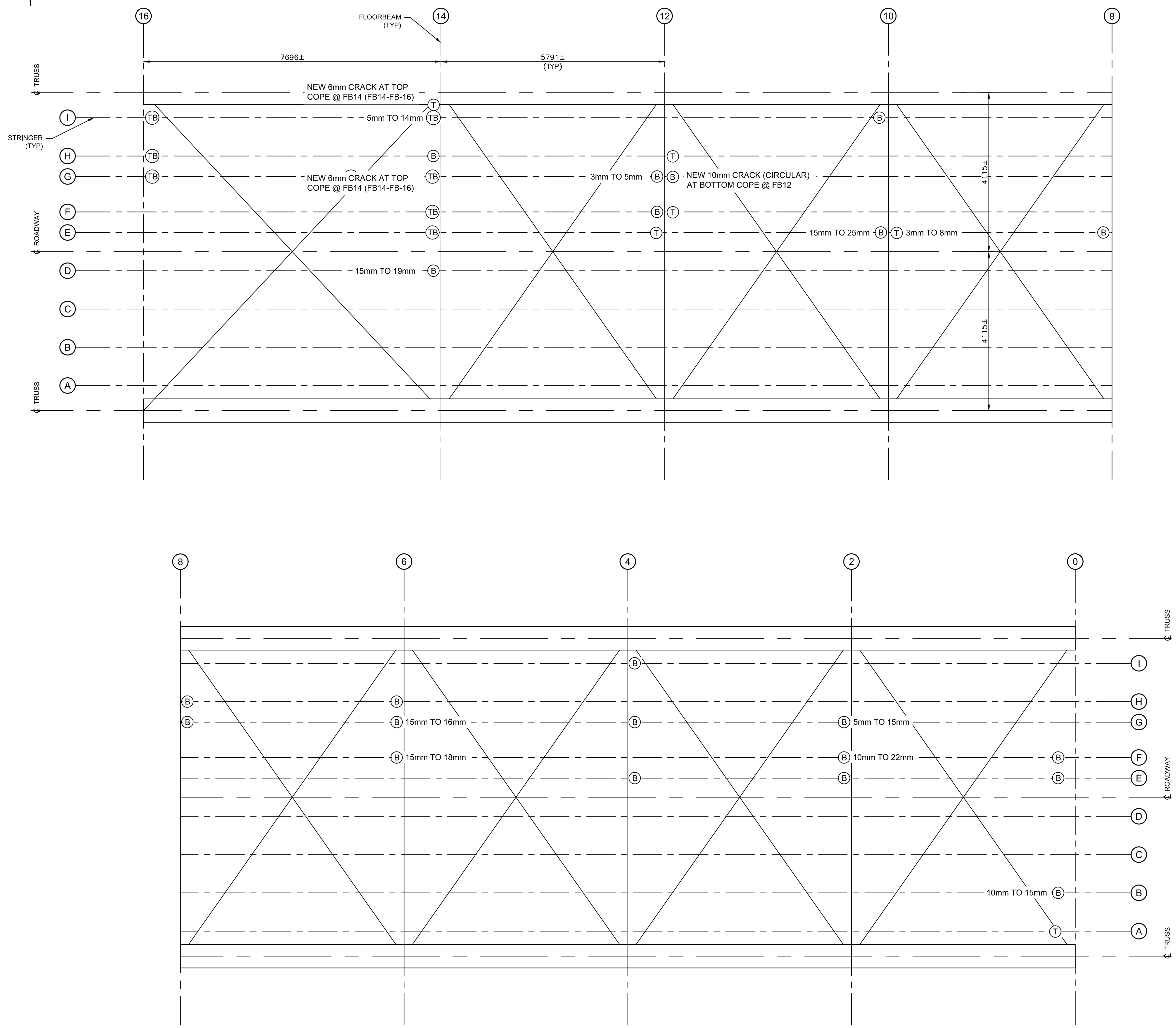
drawn by / dessiné par: R. DYNKA
designed by / conç par: S. WILLOW
approved by / approuvé par: P. HARVEY
tender / soumission: MATIN SADRZADEH — project manager / administrateur de projets
project date / date du projet: FEBRUARY 2021
project no. / no. du projet: R.090045.001
drawing no. / dessin no.: B02

GSC-B1 DATE PLOTTED: YYYY/MM/DD PLOT SCALE: PLOT_SCALE CAD FILE: S:\PRS\CAD\GROUP\CITY\ADDRESS\PROJECT NO\FILE.DWG

04 11

LEGEND/LÉGENDE

- (T) CRACK/NOTCH FOUND AT TOP COPE
- (B) CRACK/NOTCH FOUND AT BOTTOM COPE
- (TB) CRACK/NOTCH FOUND AT TOP & BOTTOM COPE
- ( ) CRACKS THAT HAVE PROGRESSED FROM 2018 TO 2019



Public Services and Procurement Canada

Services publics et Approvisionnement Canada

PARSONS

revision	description	date

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the engineer of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LaSALLE CAUSEWAY
BASCULE BRIDGE
2019 COMPREHENSIVE DETAILED INSPECTION
KINGSTON ONTARIO

drawing title / titre du dessin
FLOOR SYSTEM
STRINGER DETERIORATION

drawn by / dessiné par: R. DYNKA

designed by / conç par: S. WILLOWS

approved by / approuvé par: P. HARVEY

tender / soumission: MATIN SADRZADEH — project manager / administrateur de projets

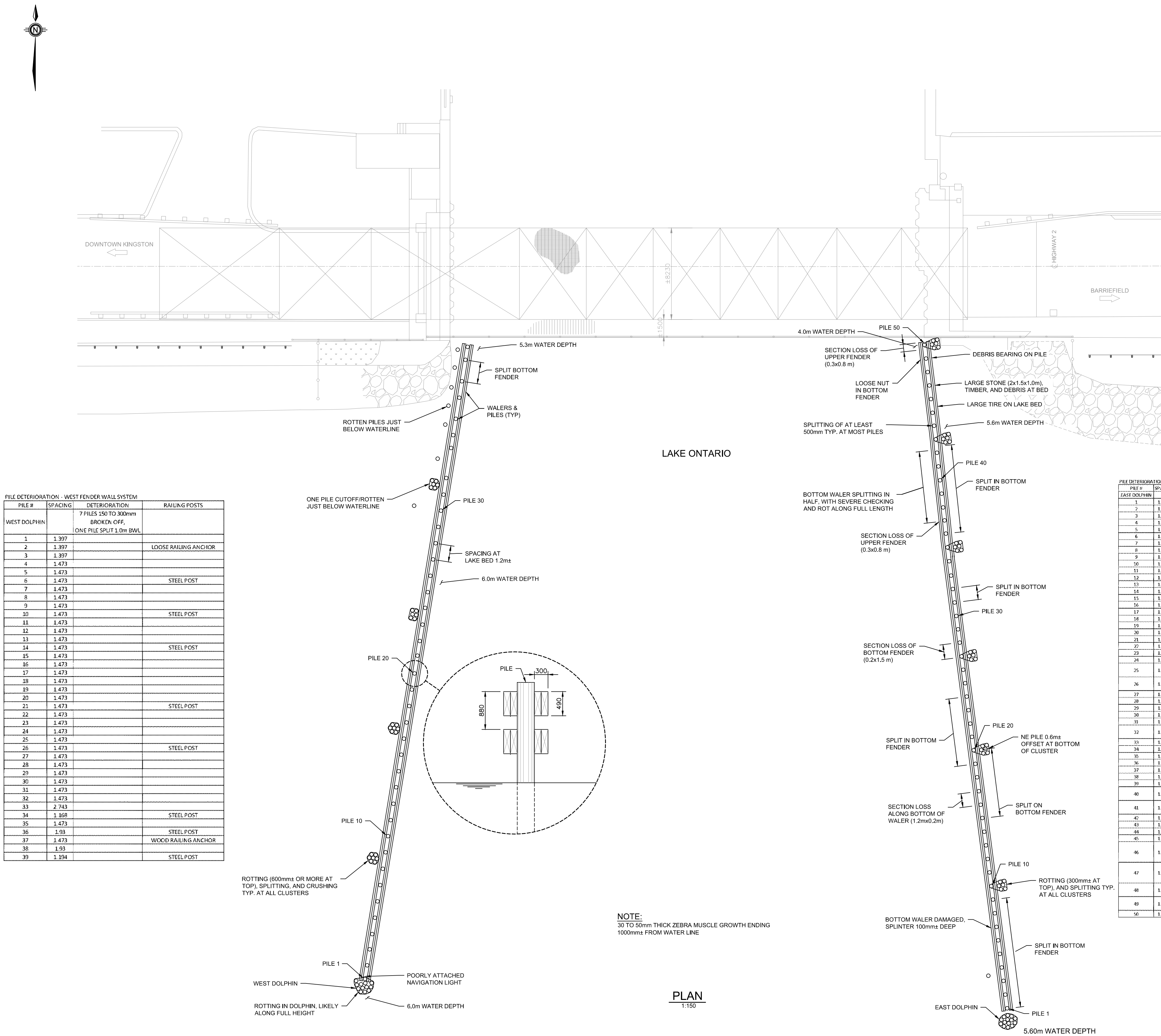
project date / date du projet: FEBRUARY 2021

project no. / no. du projet: R.090045.001

drawing no. / dessin no.: B03

GSC–B1 DATE PLOTTED: YYYY/MM/DD PLOT SCALE: PLOT_SCALE CAD FILE: S:\PRS\CAD\GROUP\CITY\ADDRESS\PROJECT NO\FILE.DWG

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 millimetres



PILE DETERIORATION - WEST FENDER WALL SYSTEM

PILE #	SPACING	DETERIORATION	RAILING POSTS
WEST DOLPHIN		7 PILES 150 TO 300mm BROKEN OFF, ONE PILE SPLIT 1.0m BWL	
1	1.397		
2	1.397		LOOSE RAILING ANCHOR
3	1.397		
4	1.473		
5	1.473		
6	1.473		STEEL POST
7	1.473		
8	1.473		
9	1.473		
10	1.473		STEEL POST
11	1.473		
12	1.473		
13	1.473		
14	1.473		STEEL POST
15	1.473		
16	1.473		
17	1.473		
18	1.473		
19	1.473		
20	1.473		
21	1.473		STEEL POST
22	1.473		
23	1.473		
24	1.473		
25	1.473		
26	1.473		STEEL POST
27	1.473		
28	1.473		
29	1.473		
30	1.473		
31	1.473		
32	1.473		
33	2.743		
34	1.168		STEEL POST
35	1.473		
36	1.93		STEEL POST
37	1.473		WOOD RAILING ANCHOR
38	1.93		
39	1.194		STEEL POST

PILE DETERIORATION - EAST FENDER WALL SYSTEM

PILE #	SPACING	DETERIORATION	RAILING POSTS
EAST DOLPHIN			
1	1.1938	SPLIT 1500mm FROM SOUTH END	
2	1.1938		
3	1.2192		STEEL POST
4	1.2192		
5	1.1430		
6	1.1430		
7	1.2954		
8	1.1938		
9	1.2192		STEEL POST
10	1.2446		
11	1.1684		
12	1.1938		
13	1.2192		
14	1.2192		
15	1.2192		
16	1.2192		
17	1.2192		STEEL POST
18	1.2192		
19	1.2192		
20	1.2192		
21	1.2192		
22	1.2192		
23	1.2192		
24	1.2192		STEEL POST
25	1.2192	500mm GOUGE LONG WIDE, 20mm DEEP, ON TOP OF LOWER WALER ON EAST SIDE	
26	1.2192	FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	
27	1.2192		
28	1.2192		STEEL POST
29	1.2192	SOME ROT ON WEST FACE OF WALER	
30	1.2192		
31	1.2192		
32	1.2192	FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	
33	1.2300		
34	1.2192		
35	1.2192		
36	1.2192	SPLIT 900mm	STEEL POST
37	1.2192		
38	1.2192	3 SPLITS 300mm	
39	1.2192	SPLIT 600mm	
40	1.2192	SPLIT 600mm, FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	STEEL POST
41	1.2192	FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	
42	1.2192	SPLIT 2.2m CHIP 210mm 10% LOSS	
43	1.2192	SPLIT300mm	
44	1.2192	ROT 150mm SPLIT 300mm	STEEL POST
45	1.2192		
46	1.2192	SPLIT 900mm 6 PIECES - NO CHANGE BWL, FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	
47	1.2192	SPLIT 300mm - 2 OLD PILES 1m BWL, FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	
48	1.2192	FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	STEEL POST
49	1.2192	FIBREGLASS JACKET FILLED WITH CONCRETE PLACED AROUND PILE AT WATERLINE AND BELOW	
50	1.2192	SPLIT 800mm BWL	STEEL POST

NOTE:
30 TO 50mm THICK ZEBRA MUSCLE GROWTH ENDING 1000mm± FROM WATER LINE

PLAN
1:150

Public Services and Procurement Canada
Services publics et Approvisionnement Canada

PARSONS

revision	description	date

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the engineer of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

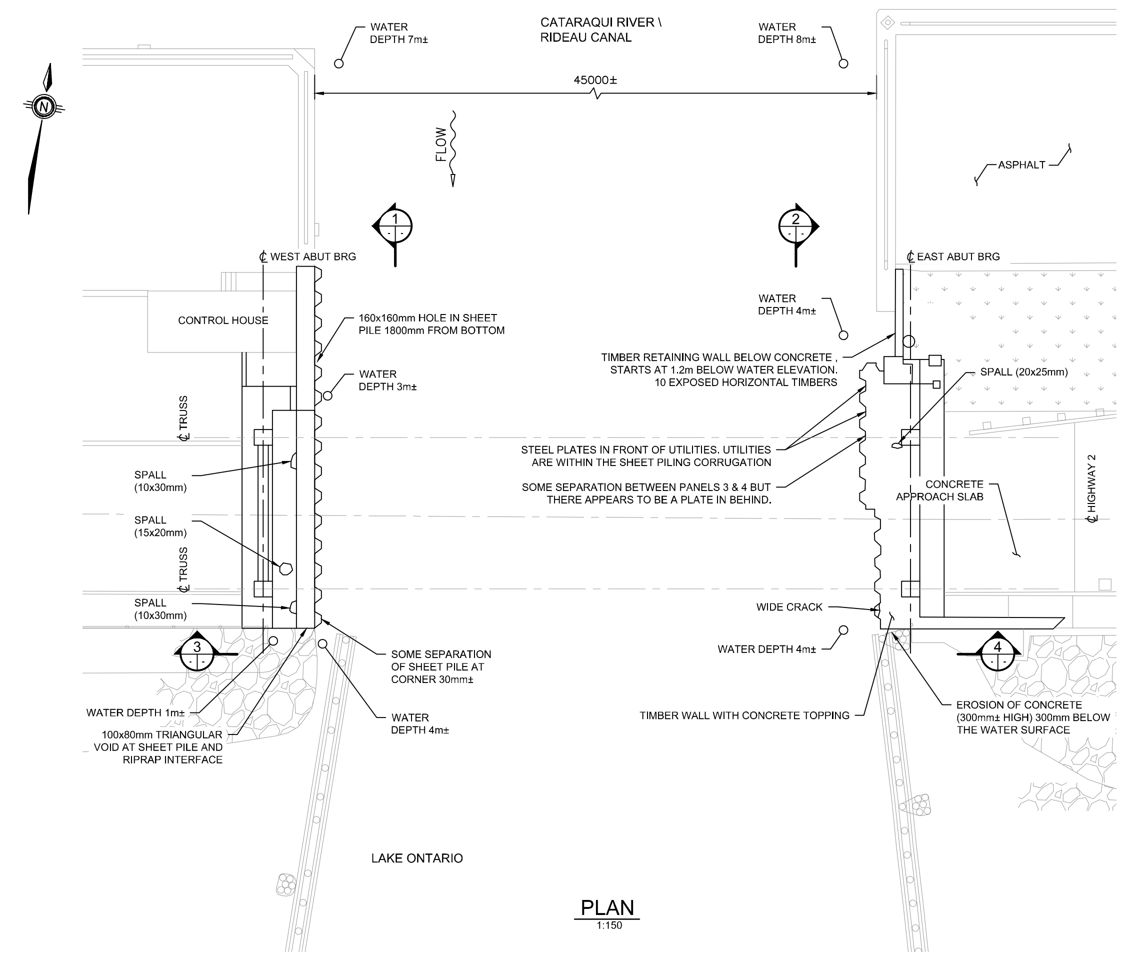
project title / titre du projet
LaSALLE CAUSEWAY
BASCULE BRIDGE
2019 COMPREHENSIVE DETAILED INSPECTION
KINGSTON ONTARIO

drawing title / titre du dessin
FENDER WALL DETERIORATION

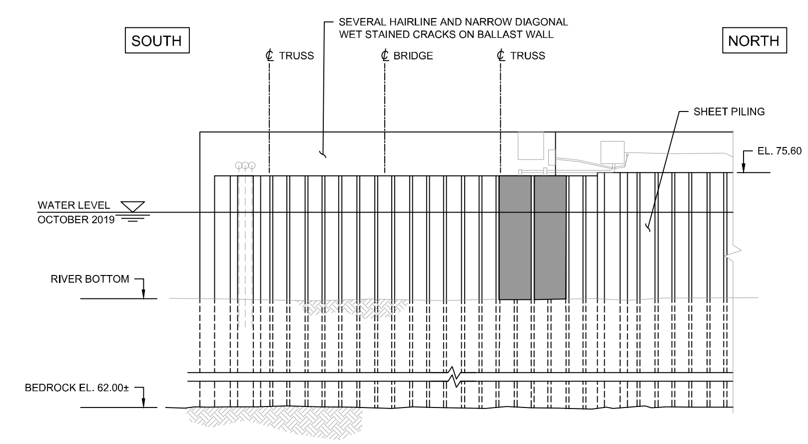
drawn by / dessine par: R. DYNKA
designed by / conc par: S. WILLOWS
approved by / approuve par: P. HARVEY
tender / soumission: MATIN SADRZADEH
project manager / administrateur de projets
project date / date du projet: FEBRUARY 2021
project no. / no. du projet: R.090045.001
drawing no. / dessine no.: B04

GSC-B1 DATE PLOTTED: YYYY/MM/DD PLOT SCALE: PLOT_SCALE CAD FILE: S:\PRS\CAD\GROUP\CITY\ADDRESS\PROJECT NO\FILE.DWG

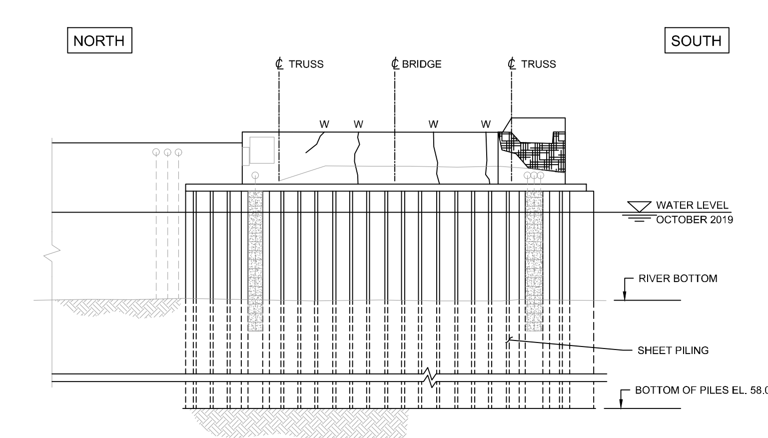
04 11



PLAN
1:150

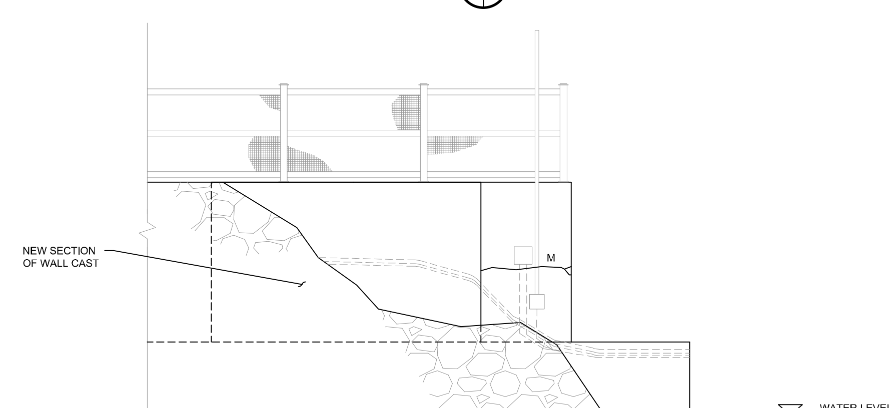


SECTION 1
1:100

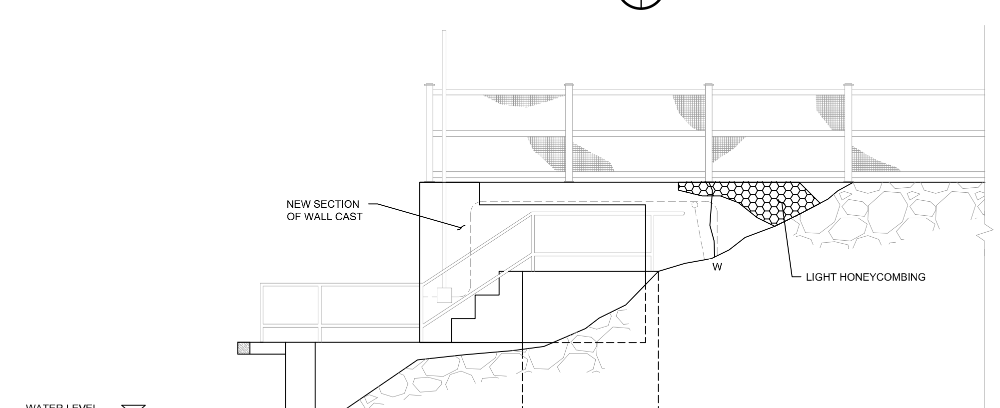


LIVE LOAD SUPPORTS NOT SHOWN FOR CLARITY

SECTION 2
1:100



SECTION 3
1:50



SECTION 4
1:50

Public Services and Procurement Canada
Services publics et Approvisionnement Canada

PARSONS

LEGEND/ LÉGENDE

- EXPOSED REINFORCING STEEL/ BARRE D'ARMATURE DÉCOUVERTE
- REPAIR/ RÉPARATION
- SPALL/ ÉCLATEMENT
- DELAMINATION/DÉLAMINATIONS
- SCALING/ ÉCAILLAGE
- DISINTEGRATION/ DÉSINTÉGRATION
- HONEYCOMBING/ NID D'ABEILLE
- WET AREA/ ZONE MOUILLÉE
- EFFLORESCENCE STAINING/ COLORATION D'EFFLORESCENCE
- MAP CRACKING/ FISSURATION À MAILLES
- RAVELLING/ARRACHEMENT
- RS RUST STAINING/ TACHES DE ROUILLE
- H HAIRLINE CRACK/ FISSURE CAPILLAIRE (<0.1 mm)
- N NARROW CRACK/ FISSURE ÉTROITE (0.1 TO 0.3 mm)
- M MEDIUM CRACK/ FISSURE MOYENNE (0.3 TO 1.0 mm)
- W WIDE CRACK/ FISSURE LARGE (>1.0 mm)
- CRACK WITH EFFLORESCENCE/ FISSURE AVEC EFFLORESCENCE
- N. NORTH/ NORD
- S. SOUTH/ SUD
- E.J. EXPANSION JOINT/ JOINT DE DILATATION
- TYP. TYPICAL
- CJ CONTROL JOINT/ JOINT DE RETRAIT

revision	description	date

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the engineer of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LaSALLE CAUSEWAY BASCULE BRIDGE
2019 COMPREHENSIVE DETAILED INSPECTION
KINGSTON ONTARIO

drawing title / titre du dessin
ABUTMENT DETERIORATION

drawn by / dessiné par: R. DYNKA
designed by / conçu par: S. WILLOWS
approved by / approuvé par: P. HARVEY
tender / soumission: MATIN SADRZADEH — project manager / administrateur de projets
project date / date du projet: FEBRUARY 2021
project no. / no. du projet: R.090045.001
drawing no. / dessin no.: B05

GSC-B1 DATE PLOTTED: YYYY/MM/DD PLOT SCALE: PLOT_SCALE CAD FILE: S:\PRS\CAD\GROUP\CITY\ADDRESS\PROJECT NO\FILE.DWG

APPENDIX C – STRUCTURAL INSPECTION PHOTOGRAPHS

Bascule Bridge, LaSalle Causeway

Photo S-1: South elevation.


Photo S-2: North elevation.

Photo S-3: Top of truss, looking east.

Photo S-4: Bridge in open position (photo from 2018 CDI).

Photo S-5: Bridge in open position, looking east.

Photo S-6: East approach, looking west.


Photo S-7: Bridge deck, looking west.


Photo S-8: North side of the counterweight and counterweight truss.


Photo S-9: East ballast wall. Note that the abutment is submerged at the time of the inspection (August 14, 2019).

Photo S-10: West abutment and ballast wall, looking south (August 14,2019).

Photo S-11: Localized severe pitting in north web of top chord member 0S-1S.

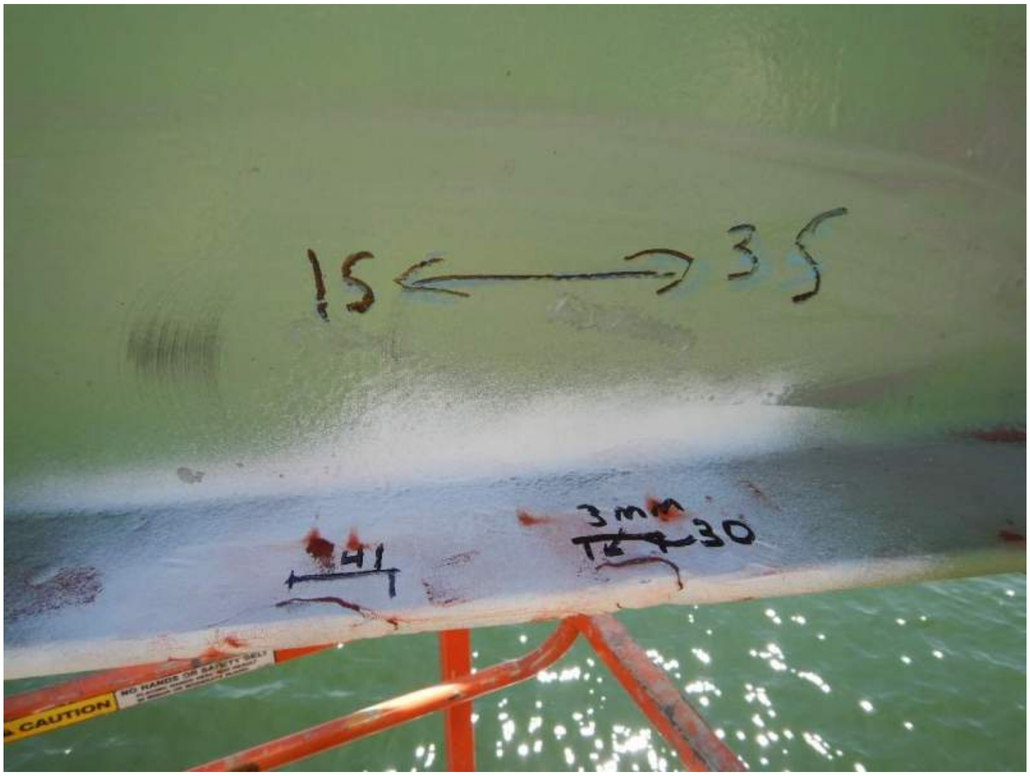


Photo S-12: A 41mm crack, and a 3mm crack propagating from a 30mm crack on the north side of the bottom web of top chord member 1S-3S (top of web).

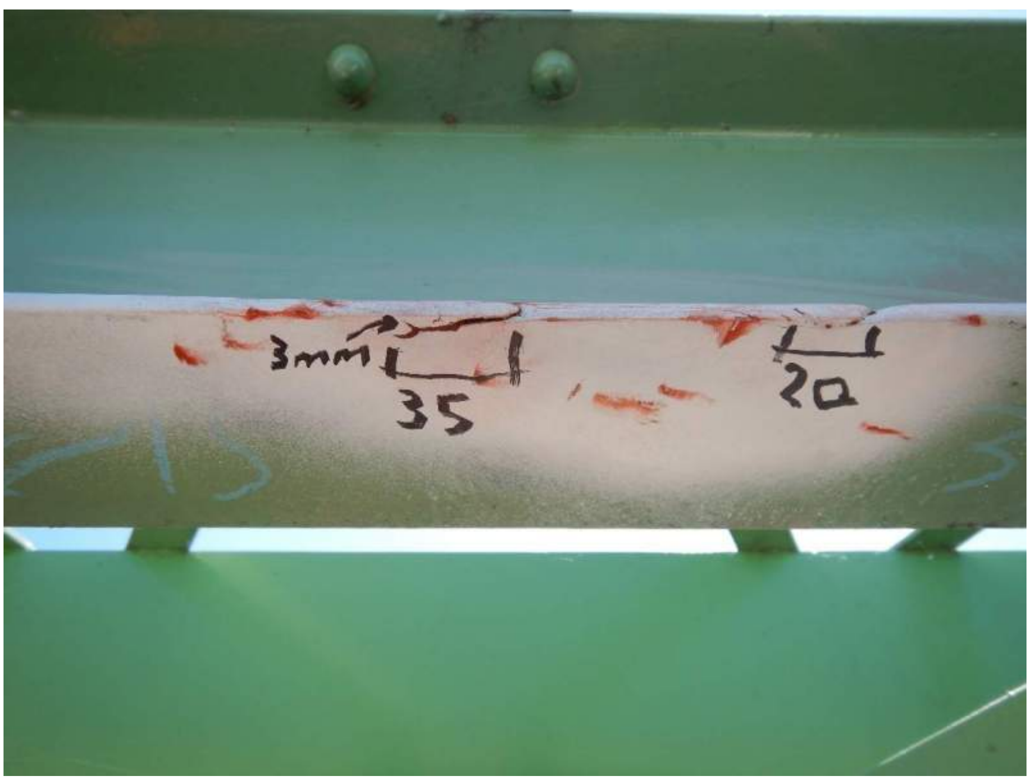


Photo S-13: A 20mm crack, and a 3mm crack propagating from a 35mm crack on the north side of the bottom web of top chord member 1S-3S (bottom of web).

Photo S-14: An 80mm long lamination defect with a 60mm long crack in the south face of top chord member 3S-5S. A diagonal crack 10mm long is propagating from the bottom, where a crack 50mm long parallel to main stress is located (not seen in photo) (photo by Brouco NDT).

Photo S-15: Perforation and severe pitting of diaphragm inside top chord member 11S-13S near node 13S.

Photo S-16: Perforation in the inner web and generalized light corrosion where coating is missing on bottom chord member 14N-16N near node 16N.

Photo S-17: Severe pitting and rust jacking between member 14N-15N and 14N-16N.

Photo S-18: Severe pitting, section loss, and peeling coating in the sidewalk floor beam connection and in bottom chord member 0S-2S at node 2S. A perforation in the web of member 0S-2S is also present.

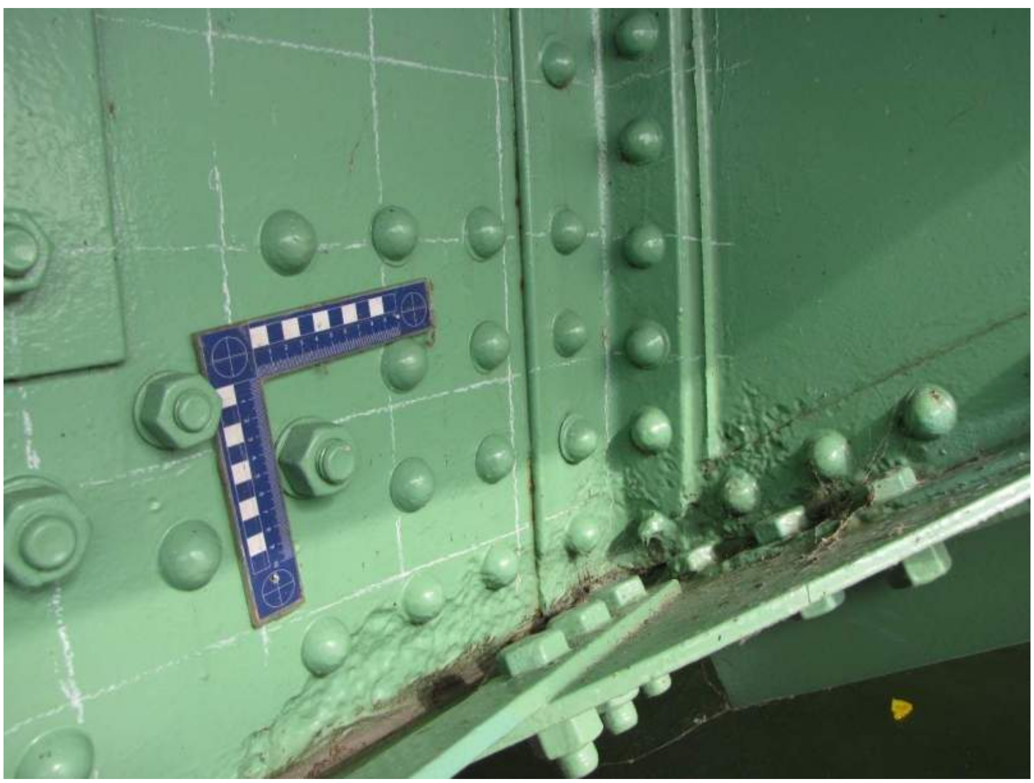


Photo S-19: Severe localized section loss of south web of bottom chord member 4S-6S at FB4.

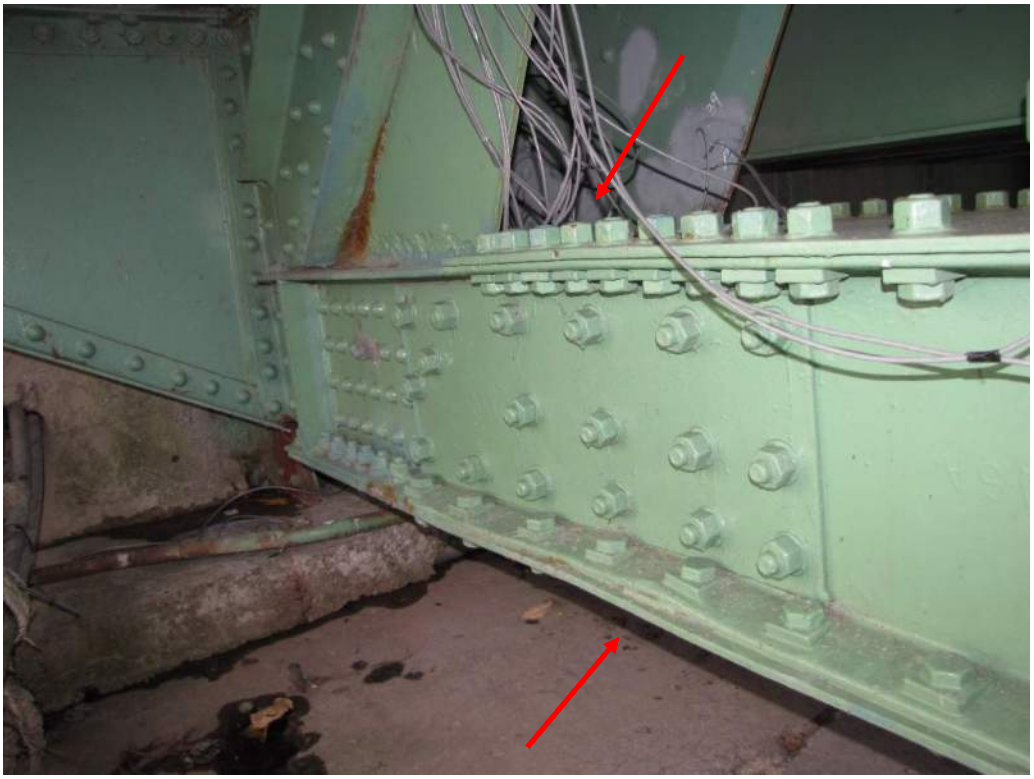


Photo S-20: The top and bottom flanges of bottom chord member 14S-16S have deformed near 16S.

Photo S-21: Two perforations and 12mm long crack in interior channel of bottom chord member 14S-16S.

Photo S-22: Severe localized pitting and section loss of flanges where 14S-16S and 14S-15S intersect. Several rivet heads have over 75% section loss.

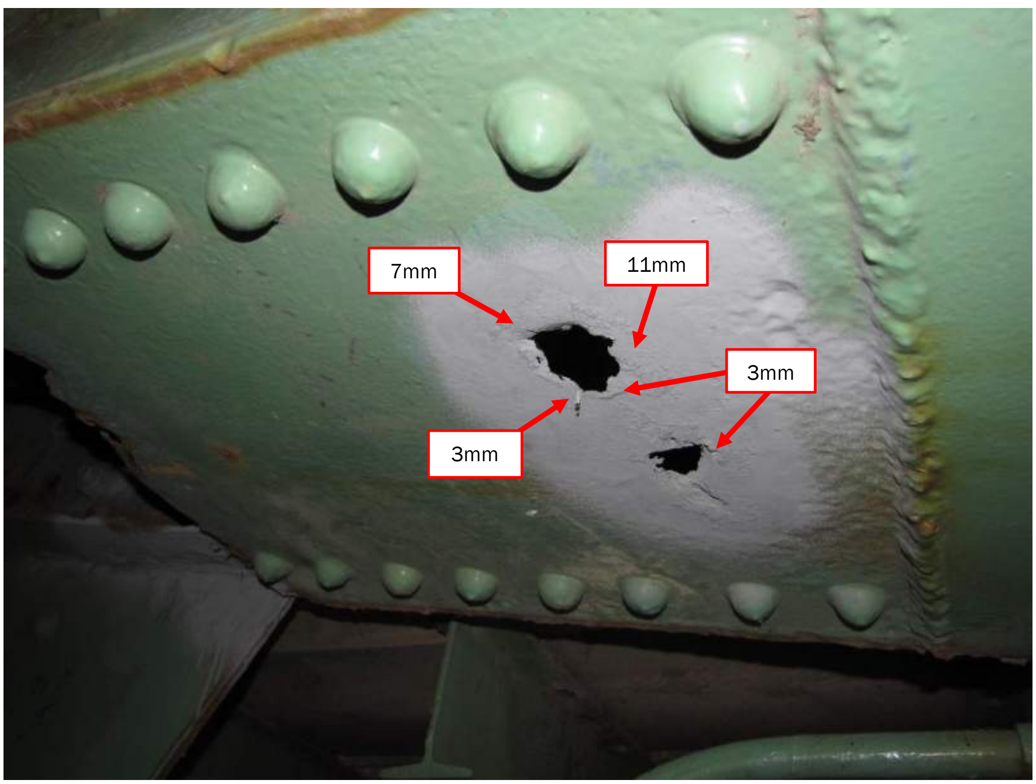


Photo S-23: Perforations and cracks in bottom batten plate of bottom chord member 14S-15S near node 15S. Cracks range in length from 3mm to 11mm.

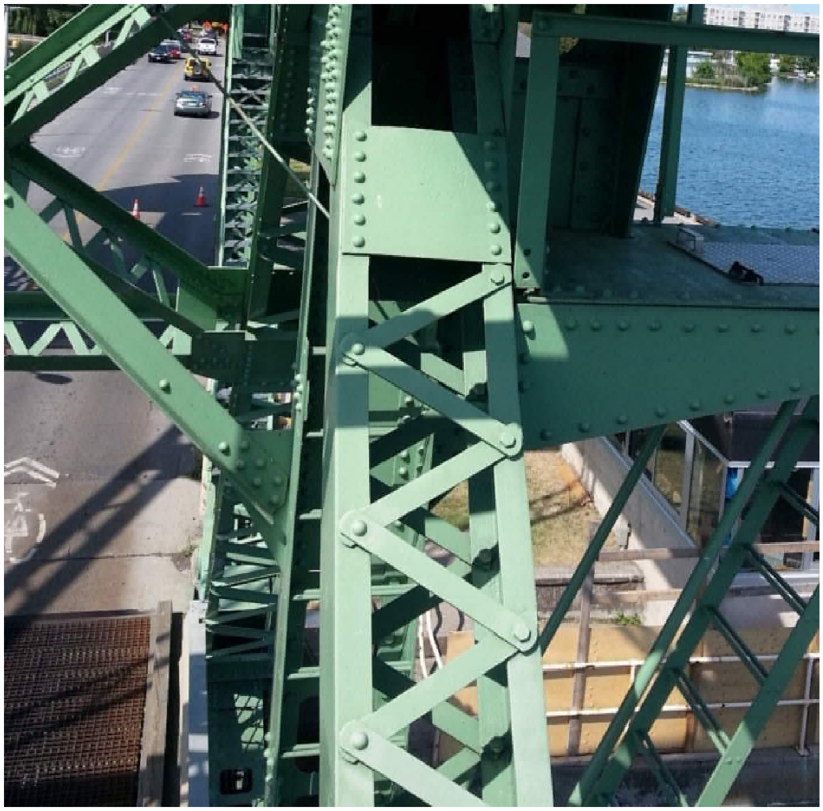


Photo S-24: The top of diagonal member 12N-13N near node 13N is deformed into an S-shape.

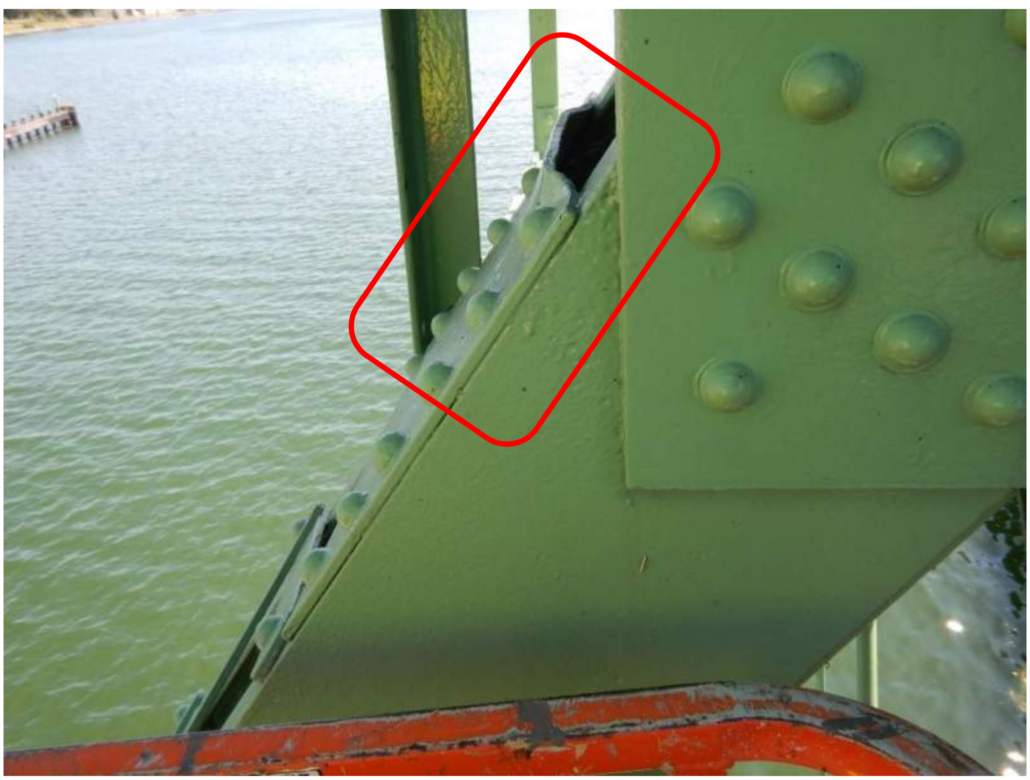


Photo S-25: The upper batten plate of diagonal member 12S-13S near node 13S is deformed.

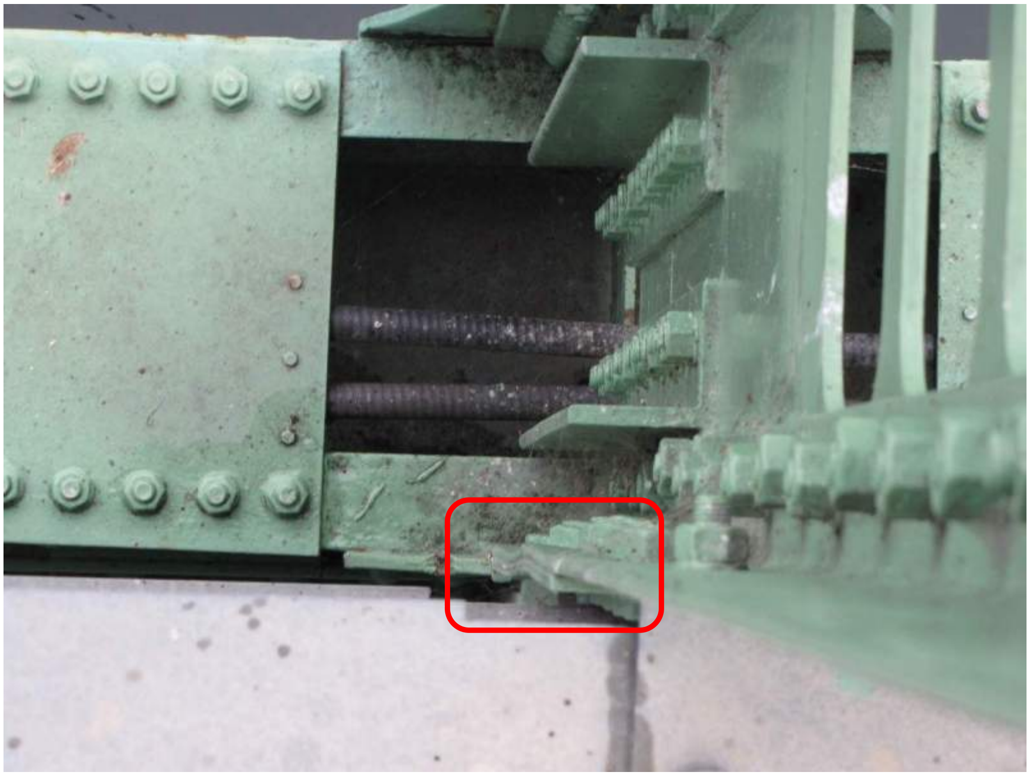


Photo S-26: The outstanding leg of the southwest angle of vertical member 1N-2N is slightly bent above node 2N (photo from 2018 CDI).

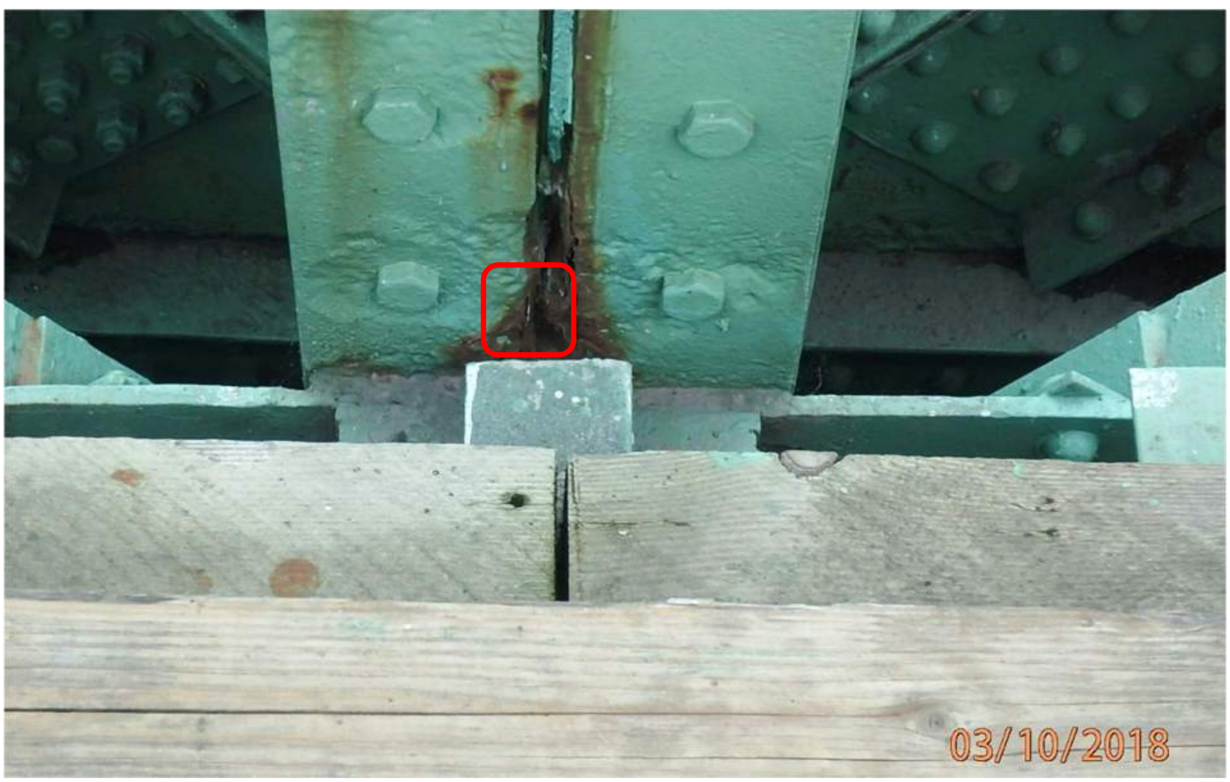


Photo S-27: Very severe pitting with a small perforation in the south angles of vertical member 9N-10N above node 10 (photo from 2018 CDI).

Photo S-28: Perforation in the south angles of vertical member 11N-12N above node 12N.


Photo S-29: Bolts used in repaired section on vertical member 13N-14N are too short.

Photo S-30: Impact damage to vertical member 1S-2S has caused the northwest flange to be slightly bent, caused coating damage allowing light corrosion to occur.

Photo S-31: 3mm long crack in top of southeast leg of vertical member 9S-10S at weld location.

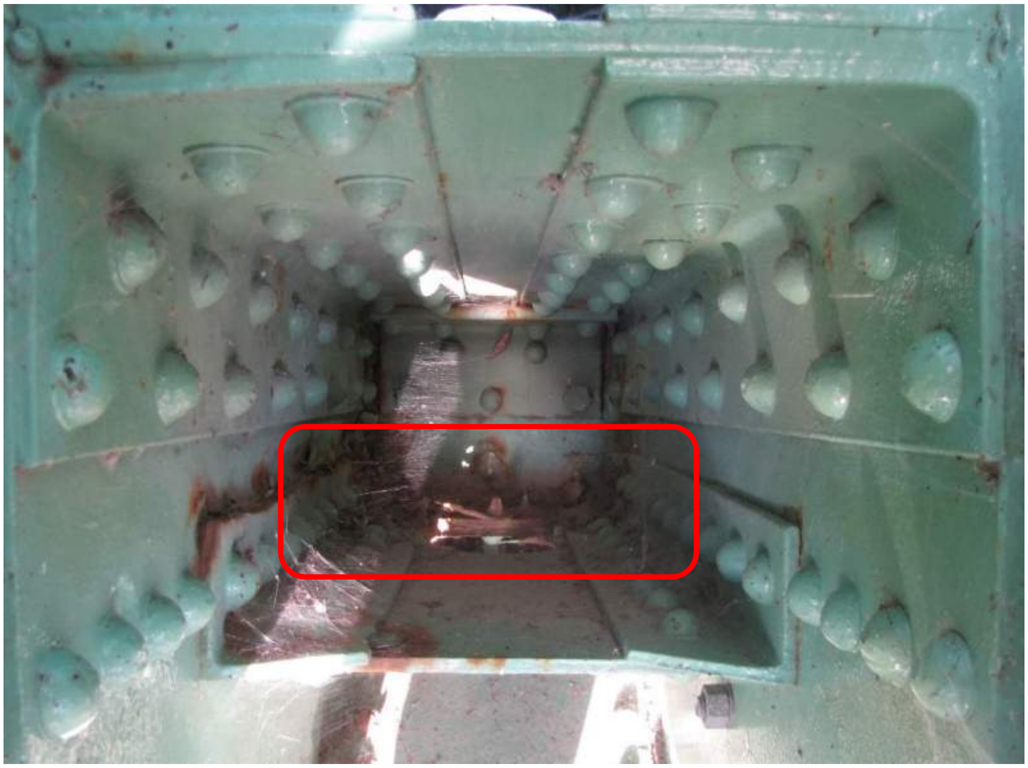


Photo S-32: Severe corrosion and section loss of rivet heads at the base of tower truss member 15N-17N and section loss of the stiffening angles and stiffening plate at the main trunnion.

Photo S-33: 4 rivet heads have 90-100% section loss in tower truss member 15N-18N near node 15N. Note the bottom flange at this location has an area of 100% section loss (not shown).

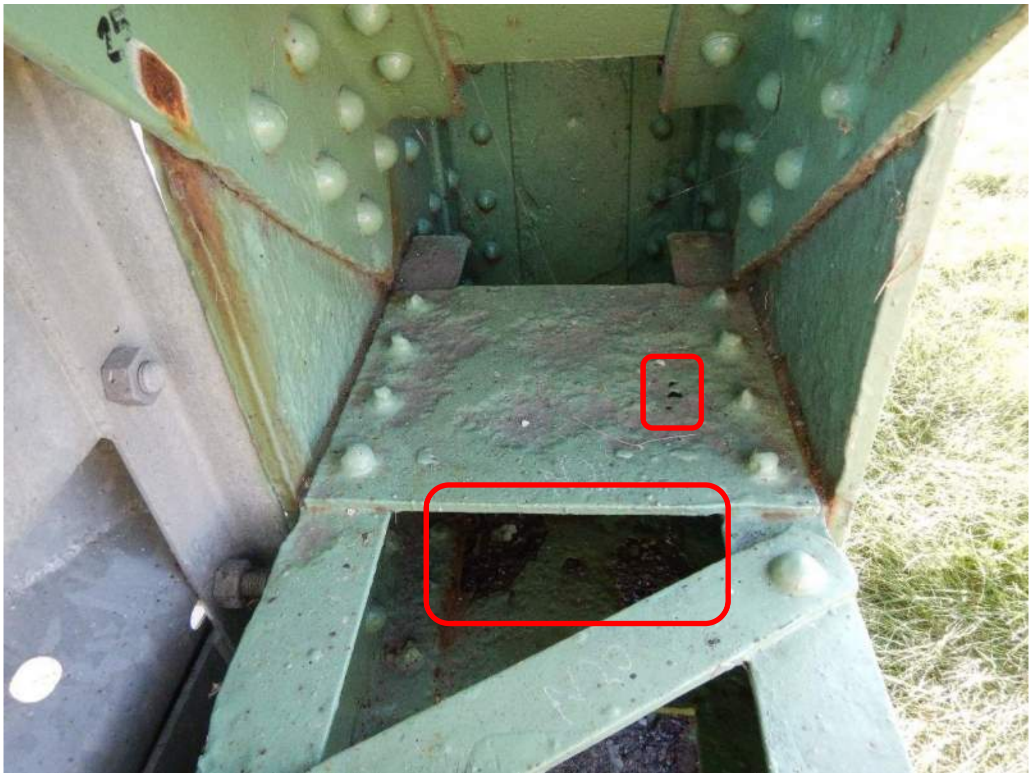


Photo S-34: Perforations in upper and lower batten plates of tower truss horizontal member 18N-19N at node 19N. Note the very severe section loss of the batten plate rivet heads.

Photo S-35: Tower truss horizontal member 18N-19N has severe section loss of interior angles and rivet heads plus a perforated lower batten plate at node 19N.

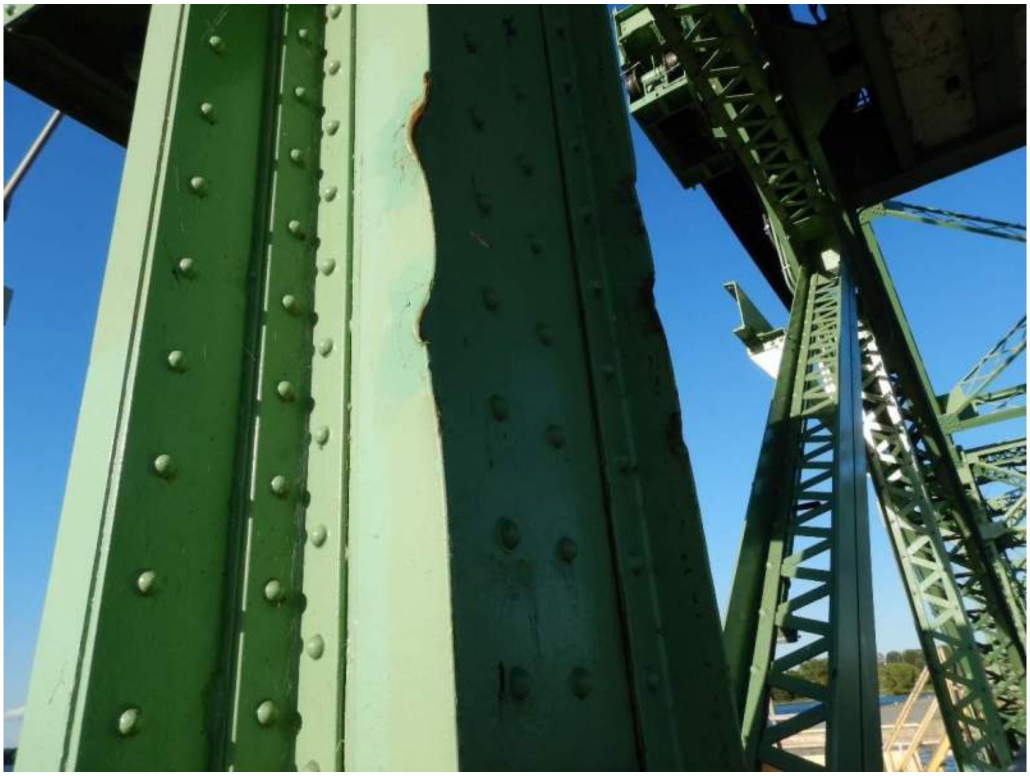


Photo S-36: The southwest and southeast flanges of tower truss vertical member 19N-20N have deformations likely caused by impact damage.

Photo S-37: Perforation and two 3mm long cracks in the south channel of tower truss horizontal member 15S-18S (photo by Brouco NDT).

Photo S-38: Fatigue crack propagating from three perforations with a total length of 70mm in the south channel of tower truss member 18S-19S.

Photo S-39: Impact damage to southeast and southwest flanges above road level on tower truss vertical member 19S-20S.

Photo S-40: Crack across full width of bottom leg of interior angle of counterweight truss member 21N-27N at node 27N (photo by Brouco NDT).

Photo S-41: The northwest end of counterweight truss cross bracing member 21S-27N has several perforations in the lower flange (left). Crack in the south lower flange of member 21N-27N (right).

Photo S-42: Localized area of pitting 2-7mm deep with a perforation above the lowest rivet in the lower batten plate on the south side of counterweight truss member 21N-22N. Also note that the outstanding leg of the angle has an area of 100% section loss.


Photo S-43: Debris and water collecting on member 26N-26S (photo from 2018 CDI).

Photo S-44: Severe corrosion on the bottom flange of the northeast transverse strut in the mechanical room.

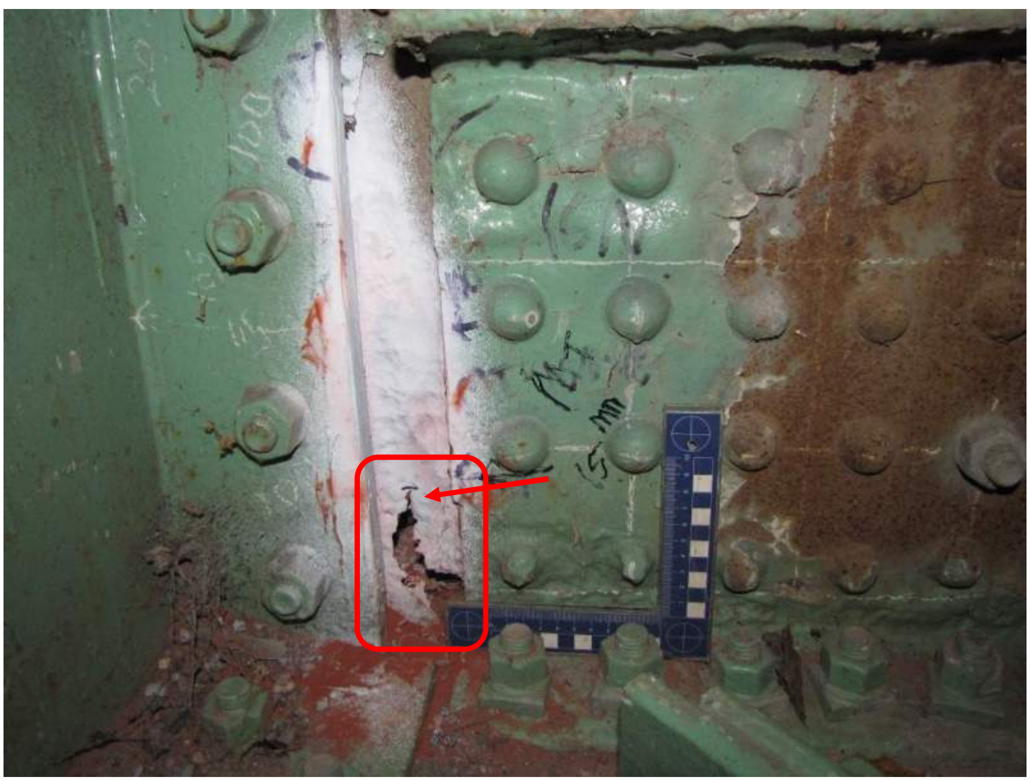


Photo S-45: The interior vertical gusset plate at node 16N exhibits severe section loss and a perforation with a 15mm vertical crack.

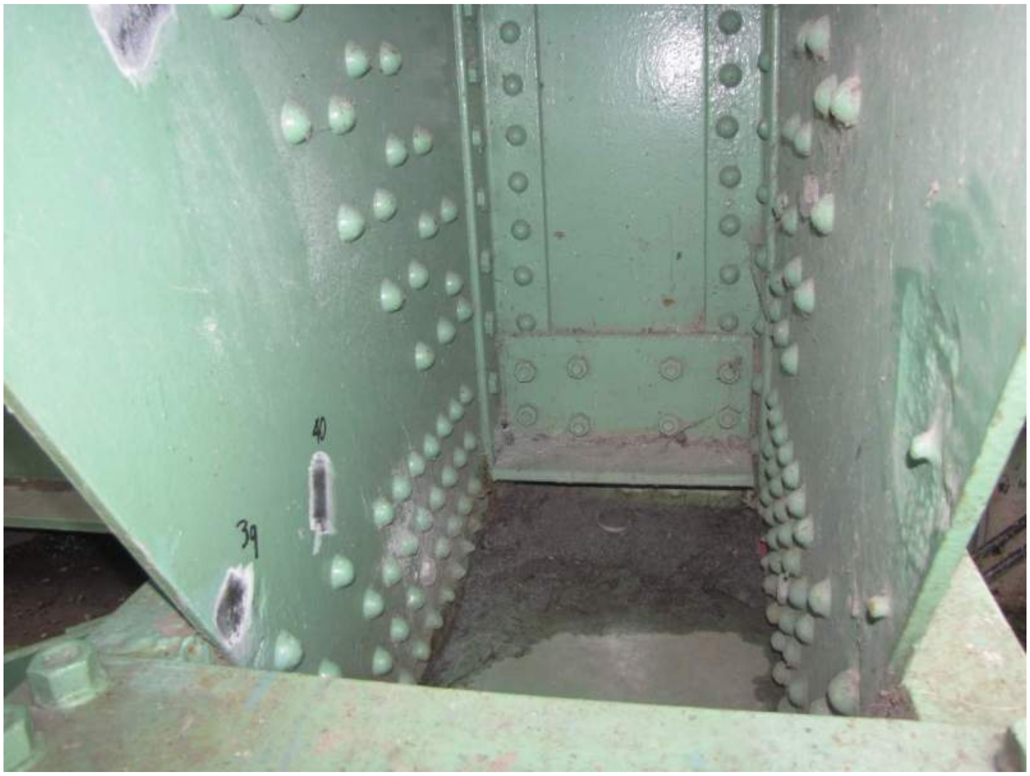


Photo S-46: The interior faces of the plates and rivet heads at the base of the north trunnion have localized severe section loss (photo from 2018 CDI).

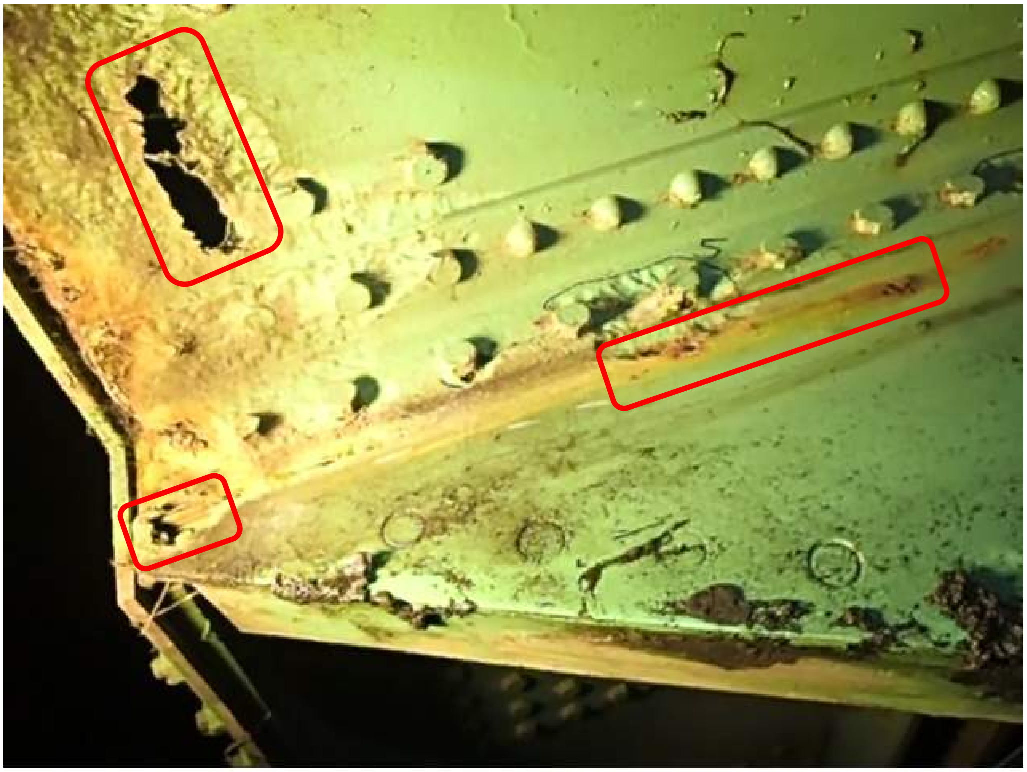


Photo S-47: Perforations in the interior face of the south plate and front plate of the north trunnion at 16N (photo from 2018 CDI).

Photo S-48: Very severe section loss in the rivet heads and angle at the base of the exterior face of the south plate of the north trunnion (photo from 2018 CDI).

Photo S-49: View of the north side of the south trunnion below deck level. A 3mm crack was found at the indicated perforation.

Photo S-50: Severe pitting at the base of the interior face and rivet heads of the south plate of the south trunnion (photo from 2018 CDI).

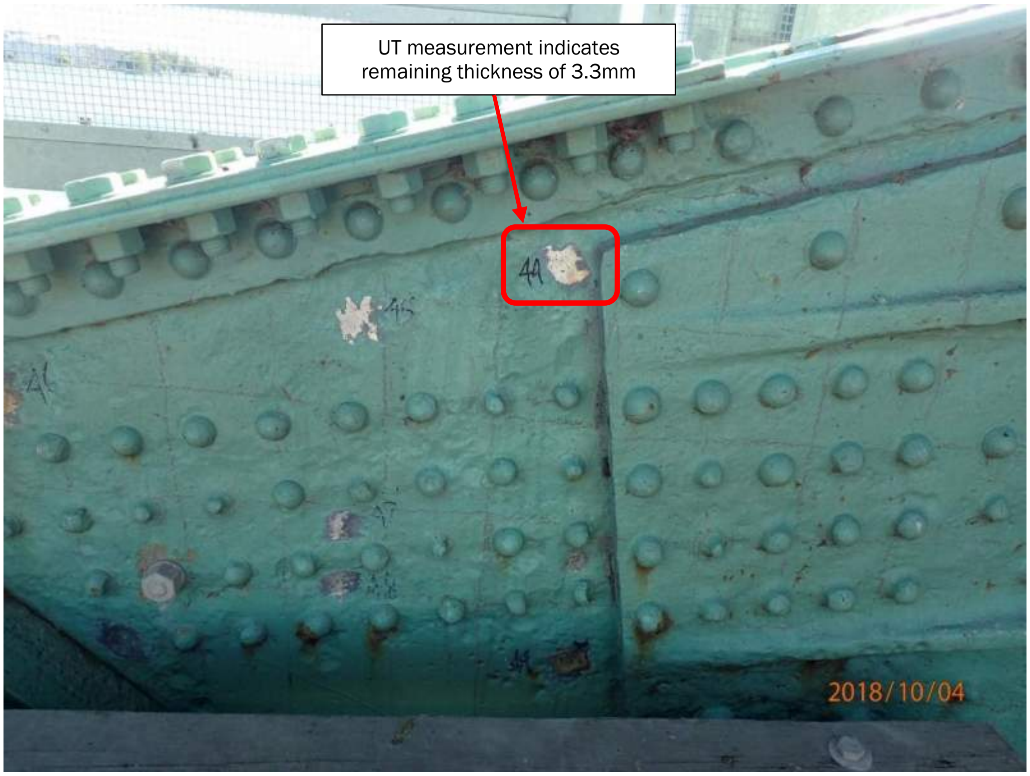


Photo S-51: The north (roadway) side of the south trunnion has widespread pitting in the collar plate (right side), connection plate (left side) and some rivet heads (photo from 2018 CDI).

Photo S-52: The north (roadway) side of the south trunnion has widespread pitting in the collar plate (not shown), connecting plate, and some rivet heads (photo from 2018 CDI).

Photo S-53: Full-width crack in southwest vertical gusset plate at 2N (no increase in length from previous inspection).

Photo S-54: Section loss and perforation in the bottom horizontal gusset plate at node 10N.

Photo S-55: The vertical gusset plate at node 15N at roadway level exhibits very severe section loss and perforations (photo from 2018 CDI).

Photo S-56: Typical localized severe pitting and section loss of bottom flange, web, and rivet heads of sidewalk floor beams at the connection to the south truss. Node 6S shown.

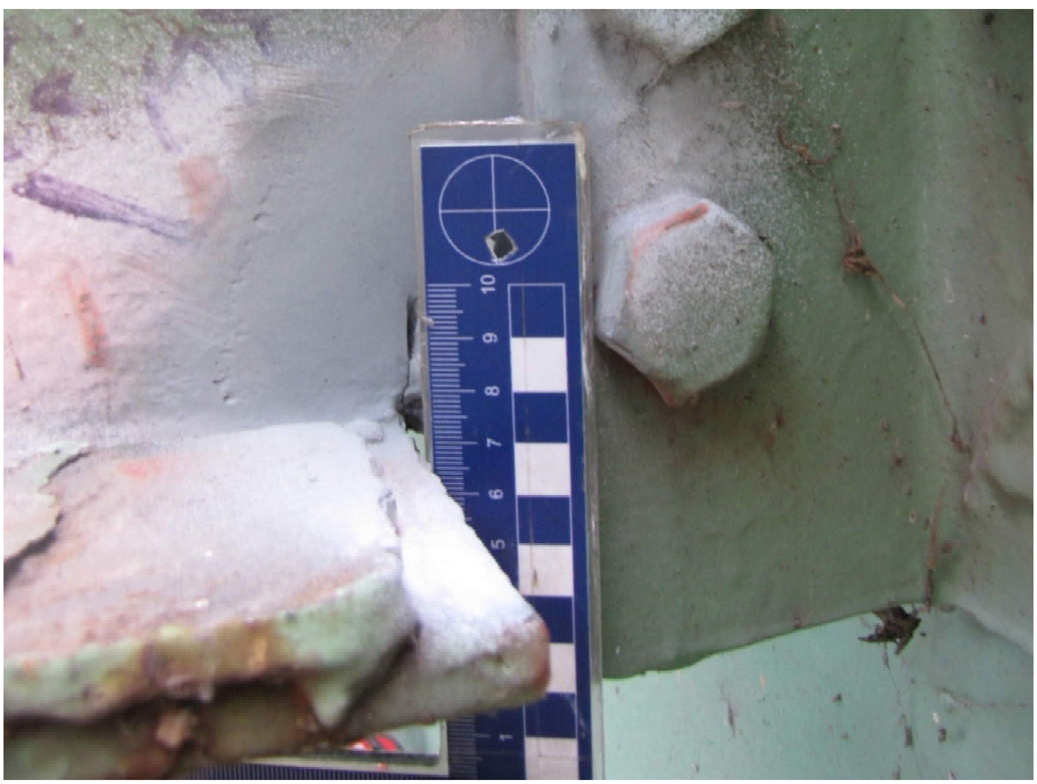


Photo S-57: 15mm notch/crack in the bottom cope of Stringer E (FB0-FB2) at FB0.

Photo S-58: 22mm notch/crack in the bottom cope of Stringer F (FB2-FB4) at FB2.

Photo S-59: 25mm notch/crack in the bottom cope of Stringer E (FB10-FB12) at FB10.

Photo S-60: 19mm notch/crack in the bottom cope of Stringer D (FB14-FB16) at FB14.

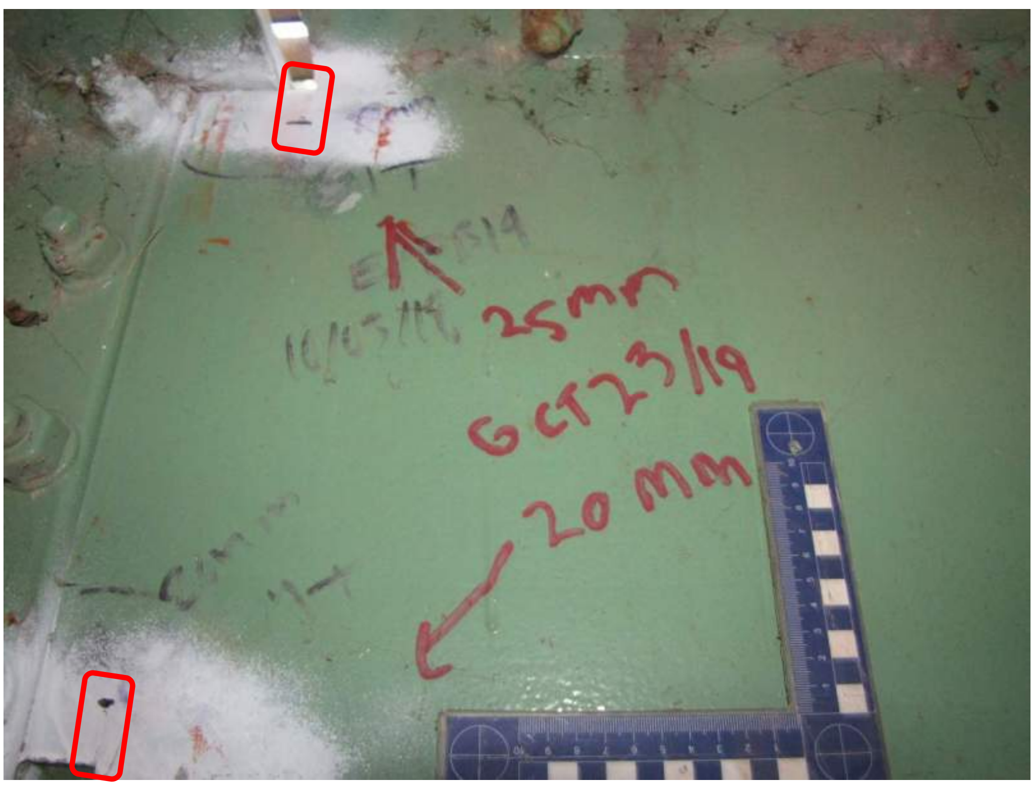


Photo S-61: 20mm notch/crack in the bottom cope and 25mm notch/crack in the top cope of Stringer E (FB14-FB16) at FB14.

Photo S-62: The sills supporting the deck grating are typically permanently deflected (photo from 2018 CDI).

Photo S-63: Multiple sills in bay 14-16 are not bearing on the stringers below (photo from 2018 CDI).

Photo S-64: One of several loose anchor bolts connecting the sills to the stringers. Several others were noted to be missing or severely corroded (not shown).

Photo S-65: The panels on the underside of the counterweight have widespread corrosion and wet areas/stains (photo taken when bridge in open position).


Photo S-66: Spalls, disintegration, map cracking, efflorescence, and wet stains were typically noted in the counterweight concrete inside the two voids in the east face (north void shown).


Photo S-67: Efflorescence deposits and staining on the underside of the counterweight concrete (photo taken after removal of the bottom east angle).

Photo S-68: Exposed, corroded rebar in the soffit of the counterweight at the southeast (photo taken after removal of the bottom east angle).

Photo S-69: The concrete in the two upper chambers in the top face of the counterweight exhibits spalls, disintegration, and wet areas (north chamber shown).

Photo S-70: The concrete in the two upper chambers in the top face of the counterweight exhibits spalls, disintegration, and wet areas (south chamber shown).

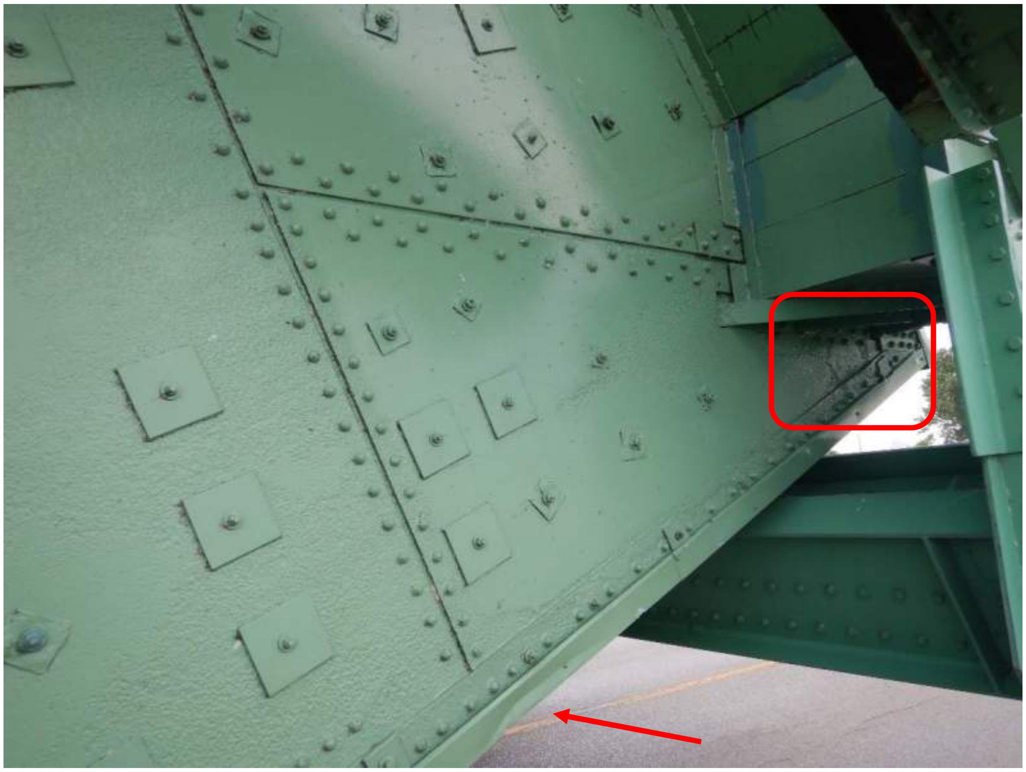


Photo S-71: The north face of the counterweight exhibits light pitting throughout, some localized areas of deep pitting, and an area of impact damage at the northwest corner (photo taken when bridge in open position).

Photo S-72: Disintegrated counterweight concrete accumulating on the soffit cladding of the counterweight on the west side (photo taken after removal of bottom west angle, prior to removal of the debris).

Photo S-73: Total amount of loose debris removed from the counterweight estimated to be between 45-70 kg.

Photo S-74: The painted coating is cracking and peeling off at several locations on the structure (node 14N below deck shown).

Photo S-75: The roadway grating has widespread light to medium corrosion along the north and south edges (north side shown). The serrated edges have been completely worn away within the wheel tracks.


Photo S-76: Cracked bearing (top) and bent cross (bottom) bars in deck grating panel 15-16 B.

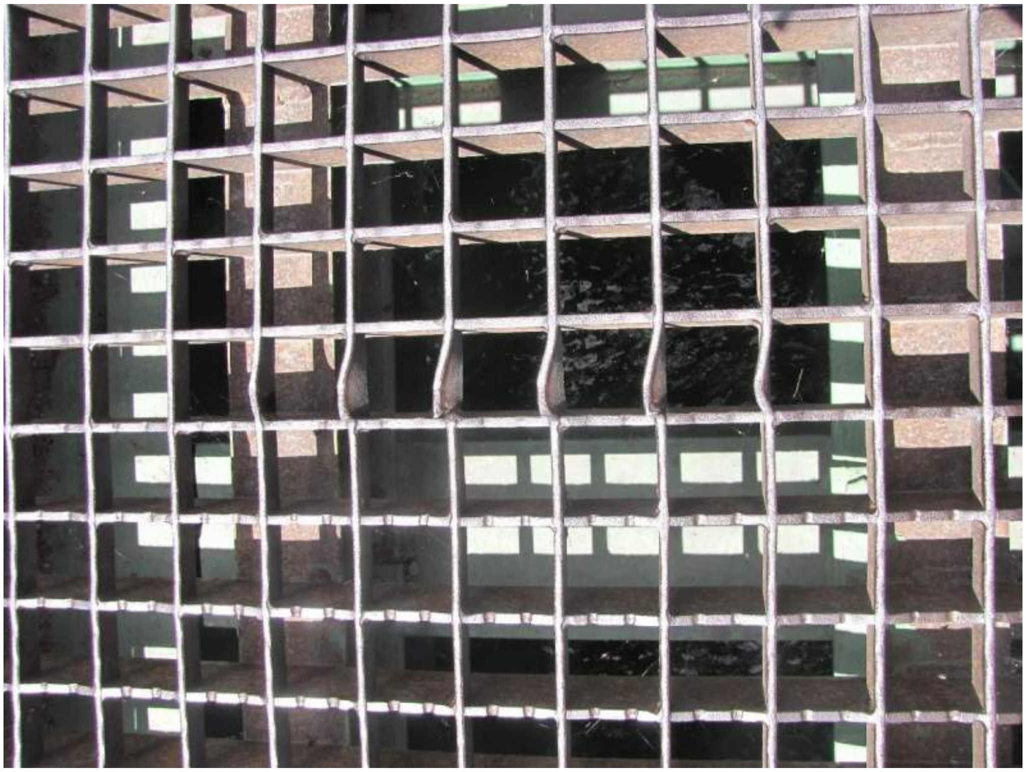


Photo S-77: Broken and bent cross bars in deck grating panel 0-2 F. The serrated edges have been completely worn away within the wheel tracks (at top of photo).

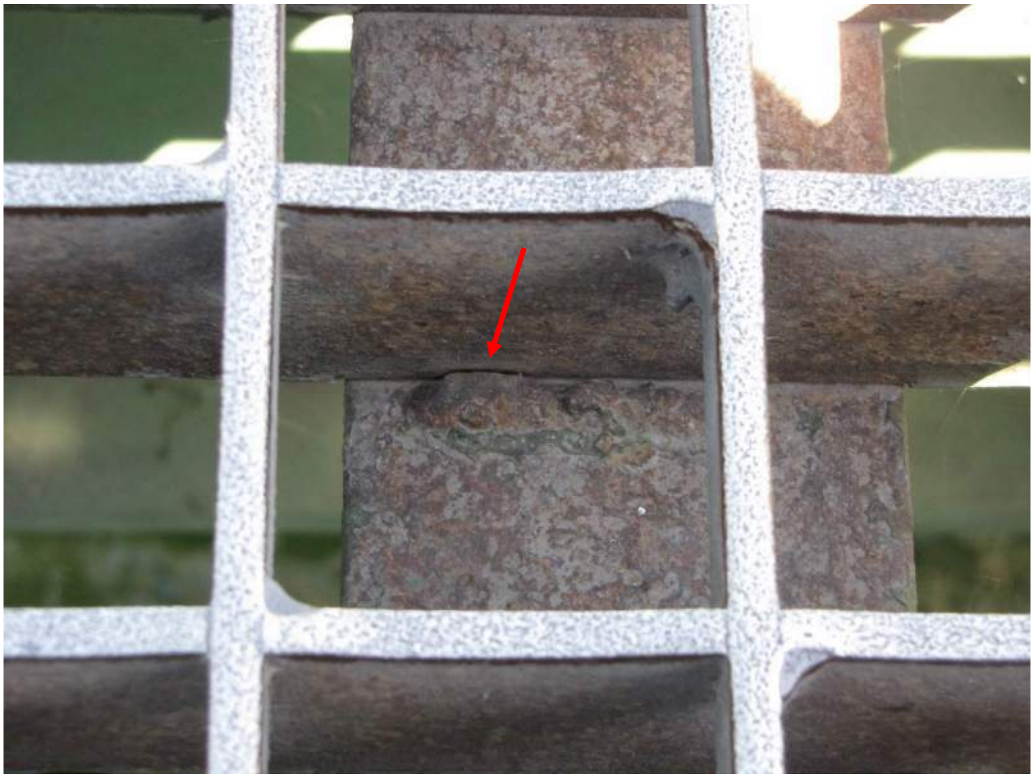


Photo S-78: Cracked bar-to-sill weld in deck grating panel 2-4 C. The serrated edges have been completely worn away within the wheel tracks.

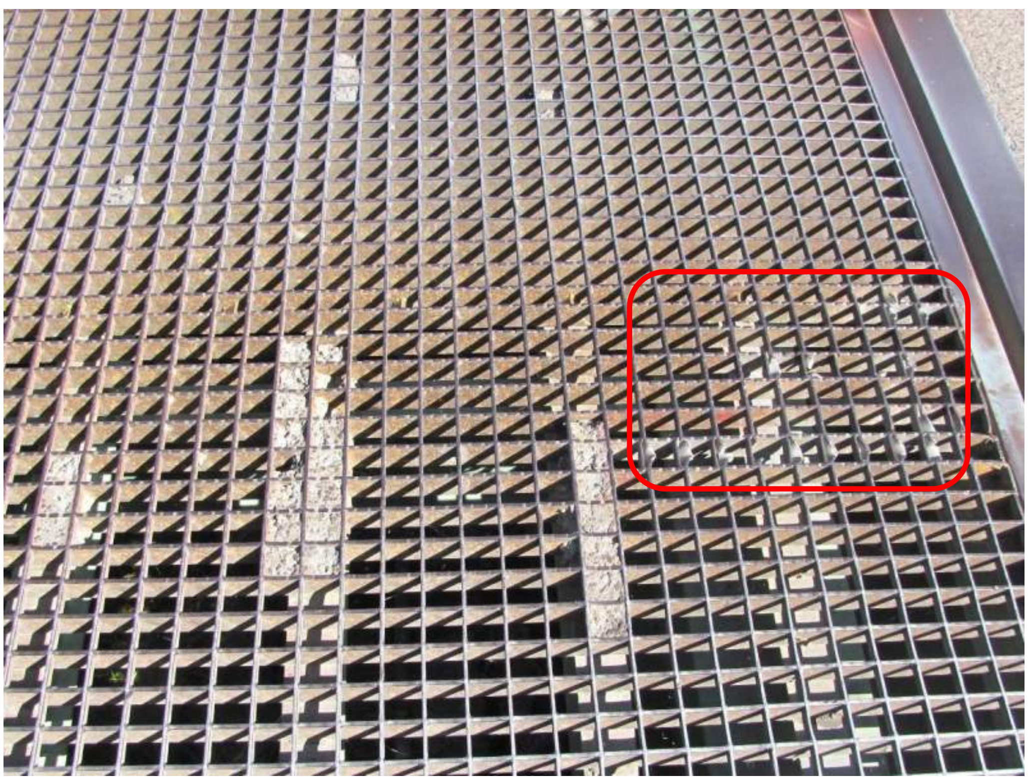


Photo S-79: Cross bar steel repairs (in red), and concrete in voids at the east end of the deck grating.

Photo S-80: View of the top of the north trunnion (node 15N).

Photo S-81: View of the top of the south trunnion (node 15S) (from 2018 CDI).

Photo S-82: Areas of coating on the interior of the north plate of the north trunnion have been worn away.

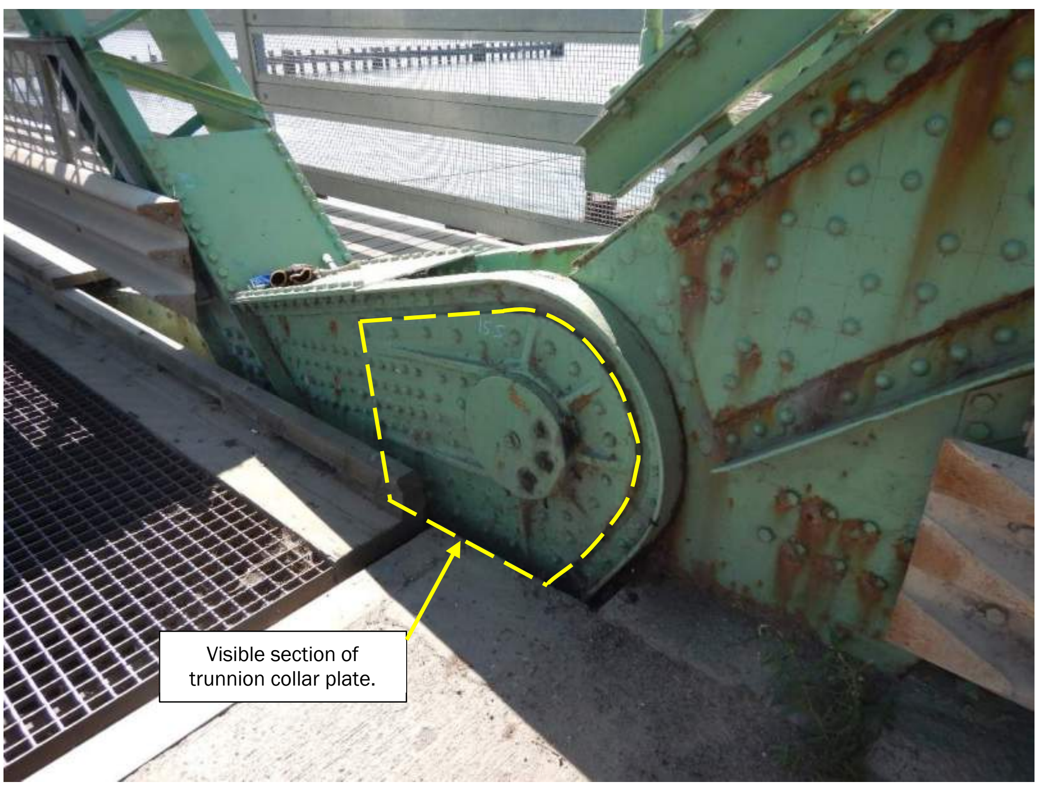


Photo S-83: The north (roadway) side of the south trunnion. Note that there is no railing between the pedestrian sidewalk and roadway.

Photo S-84: Spall in the east bearing seat with an area of about 500mm².

Photo S-85: Triangular void with an area of 1000mm by 800mm and depth of 300mm at the sheet pile/rip-rap interface at the south side of the west abutment of the Bascule Bridge.


Photo S-86: Six lattices in portal truss member 1S-1N are bent, likely due to vehicular impact of the bottom angle.


Photo S-87: The lower angle of portal truss member 1S-1N is holding water (photo from 2018 CDI).


Photo S-88: Severe impact damage to the bottom east angle of through truss sway brace member 5S-5N.


Photo S-89: Deformation of sway bracing member 9S-9N at node 9N.

Photo S-90: Tower truss sway bracing member 20N-20S has several perforations and deep pitting in the bottom gusset plate and severe section loss of the rivet heads at node 20N.


Photo S-91: Tower truss sway bracing member 20N-20S has deep pitting in the bottom gusset plate with 3 small perforations and severe section loss of the rivet heads at node 20S.

Photo S-92: Bottom west angle of counterweight truss lateral strut member 23N-23S has active corrosion and perforations at last 3 rivets at node 23S.

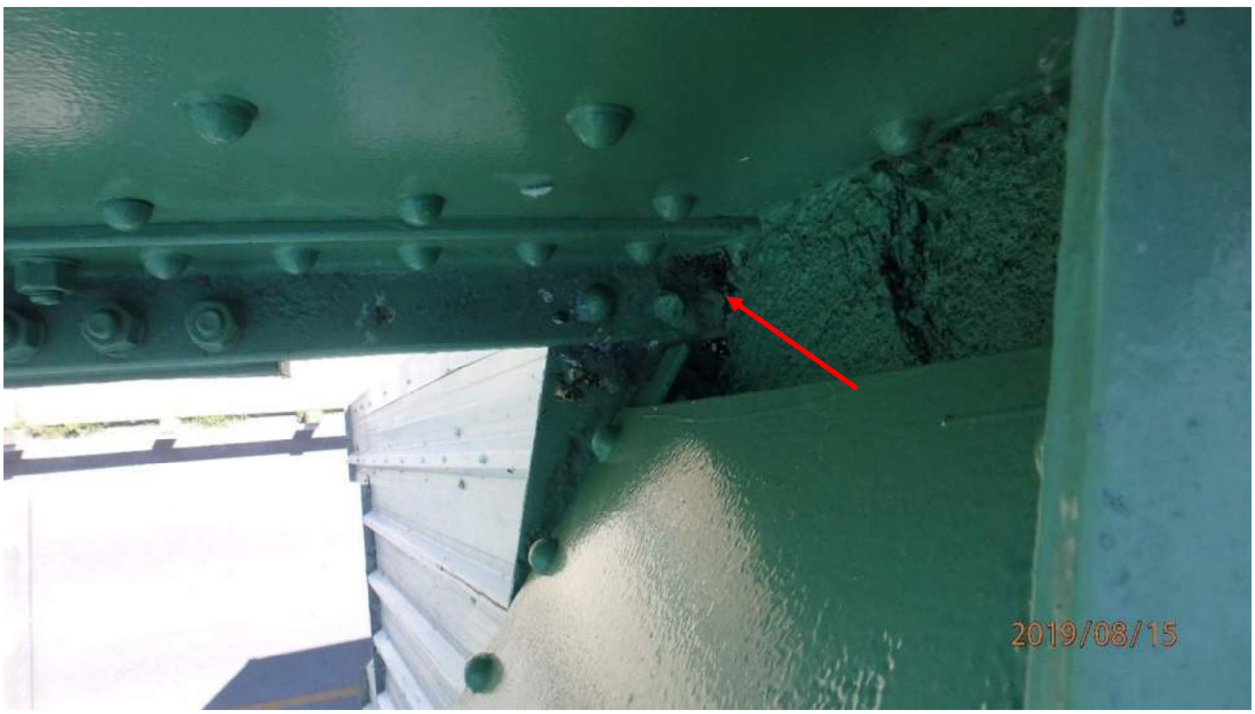


Photo S-93: Counterweight truss member 21S-27N has severe localized section loss of the lower south angle at the west end at node 27N.

Photo S-94: Lower cross bracing member 10N-12S is deformed.

Photo S-95: The bracing members that connect the cantilever sidewalk floor beams are typically sagging.

Photo S-96: The mechanical room soffit exhibits several spalls and delaminated areas (some areas indicated). Scaling of the delaminated areas is recommended as they are located over the roadway.

Photo S-97: Water was leaking into the northwest corner of the mechanical room during the inspection. Over time this has caused corrosion of the top flange of one of the steel beams supporting the motors. (photo from 2018 CDI).

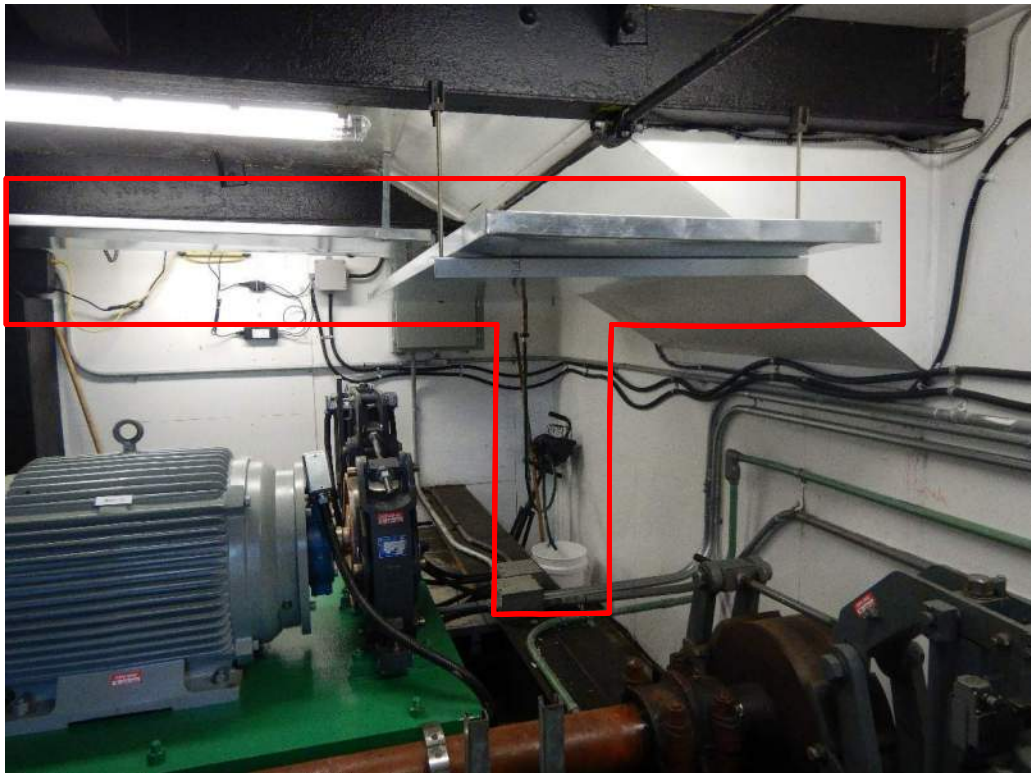


Photo S-98: A system of 2 metal trays leading to a bucket was installed in the mechanical room to catch leaking water from the roof.

Photo S-99: Bird's nest with eggs in the mechanical room at the south side at time of August 2019 inspection.

Photo S100: Areas of the west joint armouring sound hollow when sounded, indicating a void between the angle and underlying concrete (photo from 2018 inspection).


Photo S-101: Temporary timber hoarding in front of the Operator's House east railing.


Photo S-102: The east end of the north timber cur has some minor impact damage and is not anchored to the deck.


Photo S-103: Light to severe splitting and checks throughout sidewalk timber decking.

Photo S-104: Wide diagonal and vertical crack in the east ballast wall. Also note the 2 holes at the bottom of the wall, each with an area of 100 mm^2.

Photo S-105: The southeast wingwall exhibits extensive light honeycombing and a 10mm wide vertical crack extending into the concrete approach sidewalk.

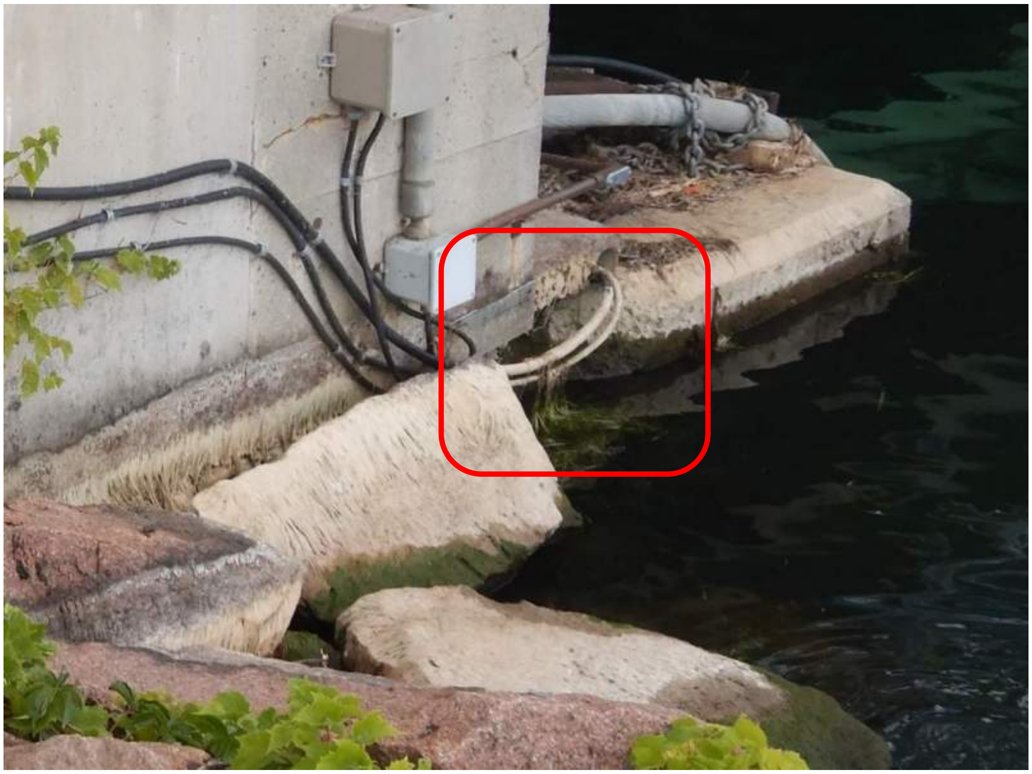


Photo S-106: Very severe spall at the base of the southwest wingwall at the interface with the abutment. Note that about half of the spall is below the water level at the time of the inspection. Also note the vegetation growth occurring below the high-water level.

Photo S-107: The northwest anchor bolt of the southeast live load support is bent and exhibits medium to severe corrosion.

Photo S-108: The leaf span is not fully seated on the north live load support and only seats fully when vehicles are on the east end of the deck. Note the light corrosion occurring on the bearing plate.

Photo S-109: There are two wide cracks that extend across the full width of the east approach slab. Also note the worn painted combination traffic/bicycle lane symbol.

Photo S-110: There is a wide crack and patched potholes at the interface between the east approach slab and adjacent roadway wearing surface.

Photo S-111: A timber post in the southwest guiderail has been split by vehicular impact.

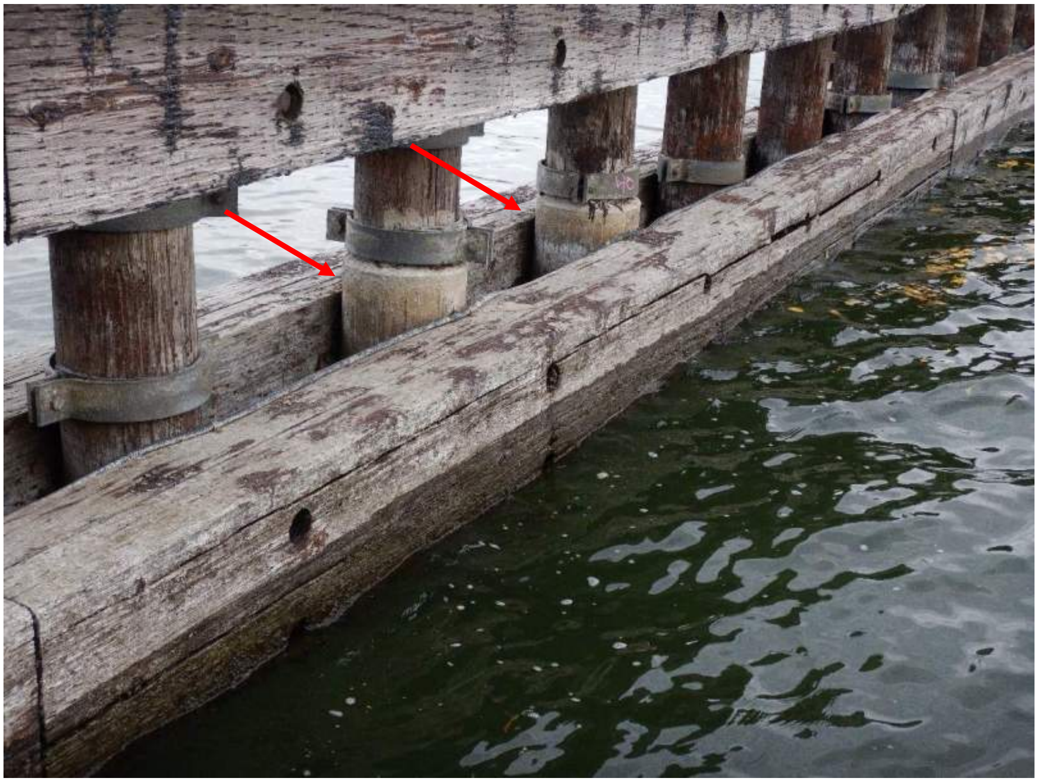


Photo S-112: The bottom waler on the west side of the east fender wall is splitting in half, has severe checking, and has rotting between piles 37 and 42. Note the fibreglass jacket filled with concrete on piles 40 and 41.

Photo S-113: The lower cables securing the dolphin to the south end of the west fender wall are loose and corroded. One pile has broken off.

Photo S-114: All pile clusters at the west fender wall have little to no structural strength as they all exhibit rotting, splitting, and crushing (third pile cluster from the north end shown).

Photo S-115: Old, rotten, and unused pile ending just below the water surface at Pile 32 of the Bascule Bridge west fender wall.

Photo S-116: Cracked weld of the east clearance sign bracket.

Photo S-117: The west clearance sign has been removed from member 1S-1N and placed on a timber post due to cracked welds in the sign bracket.

Photo S-118: The east C-channel supporting the catwalk outside the mechanical room is supported by the tapered cantilevered members below but only 25mm of the bottom flange is actually supported (photo from 2018 CDI).

Photo S-119: There are no safety chains across the two open sections of the west railing on catwalk 21N-21S which is a potential falling hazard.

Photo S-120: The east handrail is bent above node 22N.

Photo S-121: Several catwalk railing posts have split (second post from west of counterweight catwalk 21-27 north railing shown).

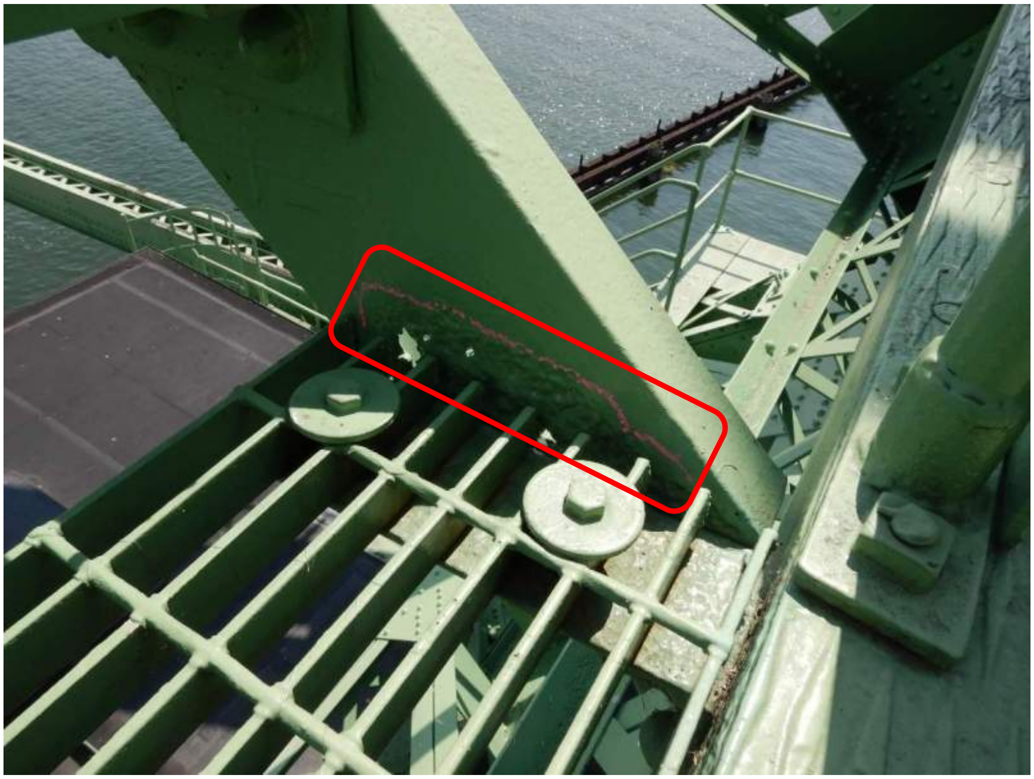


Photo S-122: Severe pitting and perforations in the north and south channel web at the bottom step of catwalk stairs from 21-22 (south shown).

APPENDIX D – MECHANICAL INSPECTION PHOTOGRAPHS

Photo M-1: Span Drive Machinery B1-N Bearing. There is light paint deterioration and corrosion between the bearing cap and base at the upper split line. The B1-S Bearing is similar.

Photo M-2: Span Drive Machinery Brake. The northeast mounting bolt nut has poor bearing. The mounting bolt and surrounding areas are lightly corroded.

Photo M-3: Span Drive Machinery North Motor. The underside of the motor mounting plate is unpainted. The span drive south motor is similar.

Photo M-4: Span Drive Machinery Gear D. Note the light damage on the south side of the closing face of this gear.

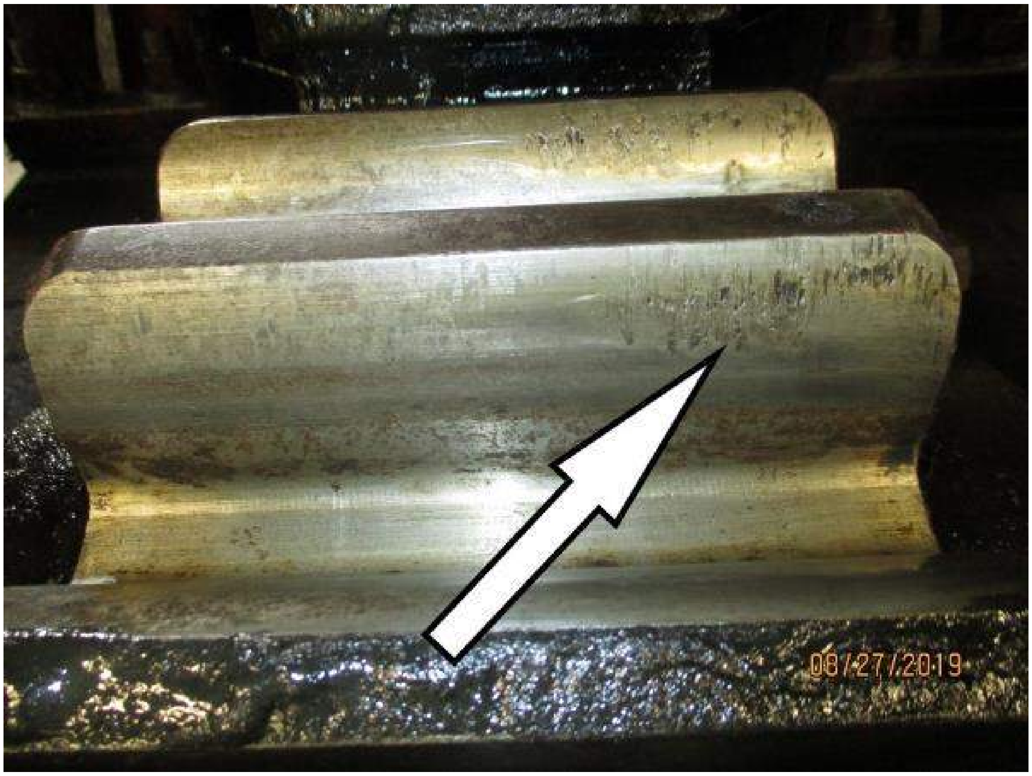


Photo M-5: Span Drive Machinery Pinion E. Note the light damage on the south side of the opening face of this pinion.

Photo M-6: Span Drive Machinery North Pinon G. The contact wear pattern indicates light cross bearing with heavier contact on the north side of the opening face and heavier contact on the south side of the closing face.

Photo M-7: Span Drive Machinery South Pinon A. There is minor metal flow and areas of minor damage to the teeth. It is difficult to distinguish between original casting defects and abrasive wear.

Photo M-8: South Operating Strut Guide Assembly. There is no access to inspect many of the machinery interfaces that are internal to the guide assembly and there is limited access to the assembly from the existing platform. Note that a man-lift was used for additional access at the time of the inspection.

Photo M-9: South Operating Strut, Outboard Bearing. The cracked paint and fretting corrosion between the bearing housing and structure indicate relative movement.

Photo M-10: North Operating Strut, Inboard Bearing. The cracked paint and fretting corrosion between the bearing housing and structure indicate relative movement.

Photo M-11: North Main Trunnion Bearing. There is contact between the moving structure and the fixed structure.

Photo M-12: Truss Near South Main Trunnion Bearing. Note the wear due to contact between the span structure and the bearing support.

Photo M-13: North Main Trunnion Bearing. The head end of the four bolts that secure the bearing housing to the structure has 100% section loss due to corrosion.

Photo M-14: North First Link Pin. There is cracked paint and fretting between the nut and the structure indicating slight movement.

Photo M-15: South Second Link Pin, Inboard Side. There is cracked paint and fretting between the link pin housing and the structure, indicating slight movement.

Photo M-16: Span Lock Gearmotor. The mounting bolts and support for the gearmotor are not fully painted. Note the corrosion.

Photo M-17: Span Lock Gearmotor Support. The support mounting bolts are not painted. Note the corrosion.

Photo M-18: Span Lock Bearing B4. The span lock mounting bolt underside is not fully painted. Note the light corrosion. The underside of bearing B4 mounting bolts are similar.

Photo M-19: Span Lock Shaft. The span lock drive shaft between bearings B3 and B4 is not painted. Note the corrosion.

Photo M-20: Span Lock Gear T. The faces of the pinion teeth are corroded. This is likely from previous lack of lubrication, as the gears were well lubricated at the time of the inspection. The teeth of pinion W, gear V, and gear T are similar.

Photo M-21: Span Lock Cross Shaft Bearing B1-S. The housing for the bearing exhibits paint deterioration and light corrosion. All of the span lock cross shaft bearings are similar.

Photo M-22: North Span Lock Crank Shaft CR1. The position indication shaft threads are not painted, and they are lightly corroded. The north location is similar.

Photo M-23: South Span Lock Crank Shaft CR2. The mounting bolts and nuts for the rotary cam position crank CR2 located on the lock bar are not fully painted and exhibit light corrosion. North Span Lock Crank Shaft CR2 is similar.

Photo M-24: North Span Lock Rotary Cam Switch.The rotary cam limit switch cover exhibits paint deterioration and light corrosion.

Photo M-25: South Live Load Strike Plate and Span Lock Receiver. General view of strike plate and span lock receiver. Note that the receiver is pushed towards the approach.

Photo M-26: South Span Lock Receiver. Close-up view of the gap between the support and shims at the northwest corner.

Photo M-27: South Live Load Strike Plate. The underside of the strike plate support and the mounting bolts are corroded. The north live load strike plate assembly is similar.

Photo M-28: North Buffer. General View of the buffer, strike plate and seated limit switch. Note the buffer is corroded. The south buffer is similar.

Photo M-29: Southeast Warning Gate. The gate arms and gate housings had spotty areas of corrosion. The other gates are similar.

Photo M-30: East Warning Gates. The warning gate arms are not horizontal in the lowered position. The west warning gates are similar.

APPENDIX E – ELECTRICAL INSPECTION PHOTOGRAPHS

Photo E-1: Utility Meter. The bridge electric service is provided with a utility meter that is located inside the operator's control house and is mounted on the side of the MCC. Note both the meter and metering pan are in good condition.

Photo E-2: Standby Generator. The standby generator was installed in 2015 to provide a backup source of power for the bridge facilities in the event of utility power failure. Note that the generator, since the original drives and motors were replaced, is now capable of handling of span operation with one operating drive motor. Also note the generator and generator housing is in excellent physical condition.

Photo E-3: Standby Generator Breakers. The standby generator is provided with a 60A main disconnect breaker and a 60A load test breaker. Note the generator is not provided with a load bank and the load test breaker is not connected.

Photo E-4: Manual Transfer Switch (MTS). A manual transfer switch has been mounted on the side of MCC in the operators control house to allow the transfer of power between utility power and the generator power. This MTS is in excellent physical and operational condition.

Photo E-5: Motor Control Centre (MCC). The bridge is provided with a motor control center (MCC) for bridge power distribution. The MCC is located inside the operator's control house. The MCC was installed in 1994 and is in fair serviceable condition.

Photo E-6: Ground Fault Indicators. A ground fault indicator light is provided for each phase of the 3-phase power. These indicator lights are provided on the MCC main breaker cubicle and were in an operational condition at the time of the inspection.

Photo E-7: Span VFD Drive Cabinet. The span variable frequency drives are newly installed and replace the original drive motor controllers for the span drive. The new VFD drives are located in their respective drive enclosures and provide excellent and variable speed and torque control for the operating bridge.

Photo E-8: Typical Span Drive Motor. The bridge is provided with two span drive motors, the two motors can be configured to operate the span simultaneously or they can be configured to operate the span individually. These span drive motors are squirrel-cage induction type and replaced the original wound rotor motors when the new VFD drives were installed.

Photo E-9: Typical Dynamic Braking Resistors. Dynamic braking resistors have been installed in conjunction with the VFD drives to provide speed and torque braking control for the span drive motors. These resistors were installed when the VFD drives were installed and are in freestanding enclosures located behind the MCC.

Photo E-10: Span Drive Motor Disconnects. The span drive motors are provided with local disconnect switches as per Canadian Electrical Code. These disconnect switches were installed as the same time as the new drive motors and are in as new condition.

Photo E-11: Typical Motor Brake. The motor brakes are in as-new physical and operational condition and are provided with set, released, and hand released limit switches as per code.

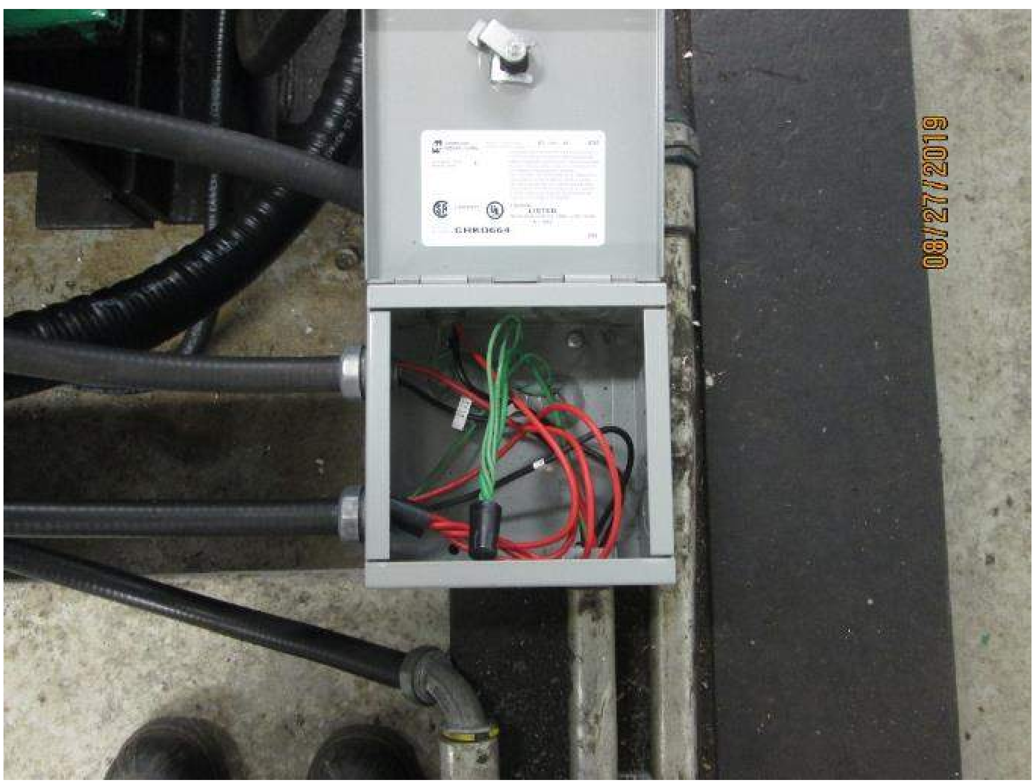


Photo E-12: Junction box near motor brake #1. Note the use of wire-nuts inside the junction box.

Photo E-13: Manual (Machinery) Brake & Disconnect. A manual brake with a local disconnect switch is provided in the bridge machinery space. Only set and released limit switches have been provided for this brake; the code required brake hand released limit switch has not been provided.

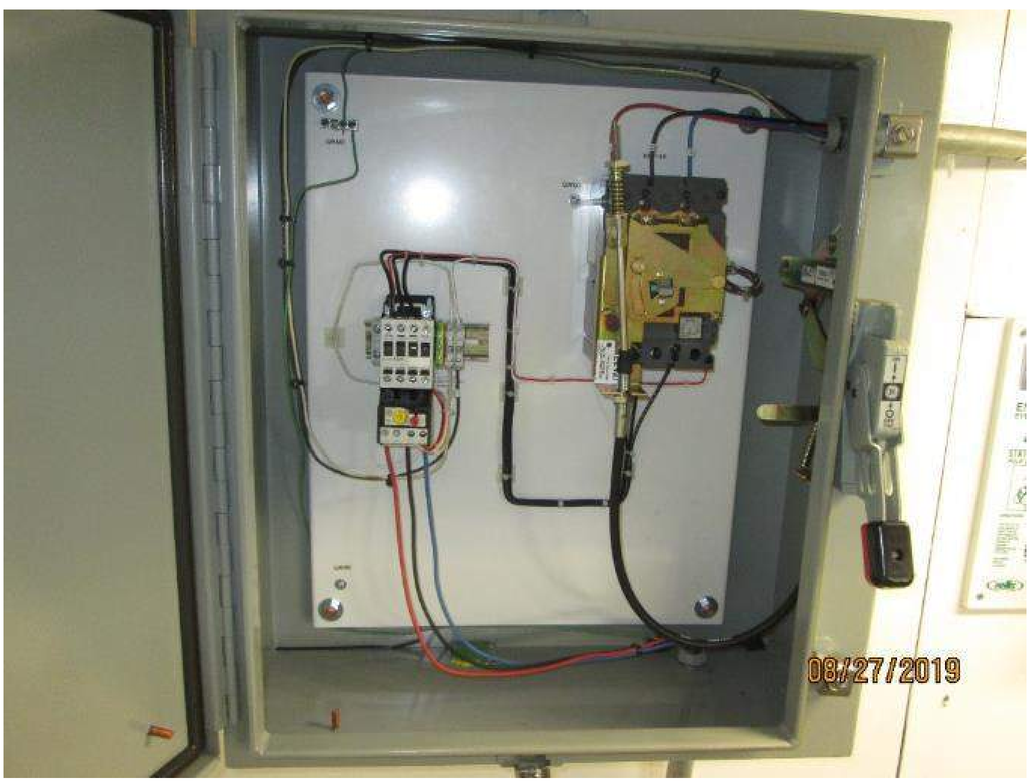


Photo E-14: Motor Brake Disconnect and Starter enclosures. New motor brake starters were recently installed in the bridge machinery space and are in excellent condition. The MCP of the motor brake starter also serves as the local disconnect switch. The wires in the enclosure have not been labelled to aid troubleshooting.

Photo E-15: Span Lock Starter Compartment. Note the span lock was originally designed with 6-speed operating steps. However, at the time of the inspection the span lock was operating at single speed only and the speed stepping contactor and resistor circuit had been disabled.

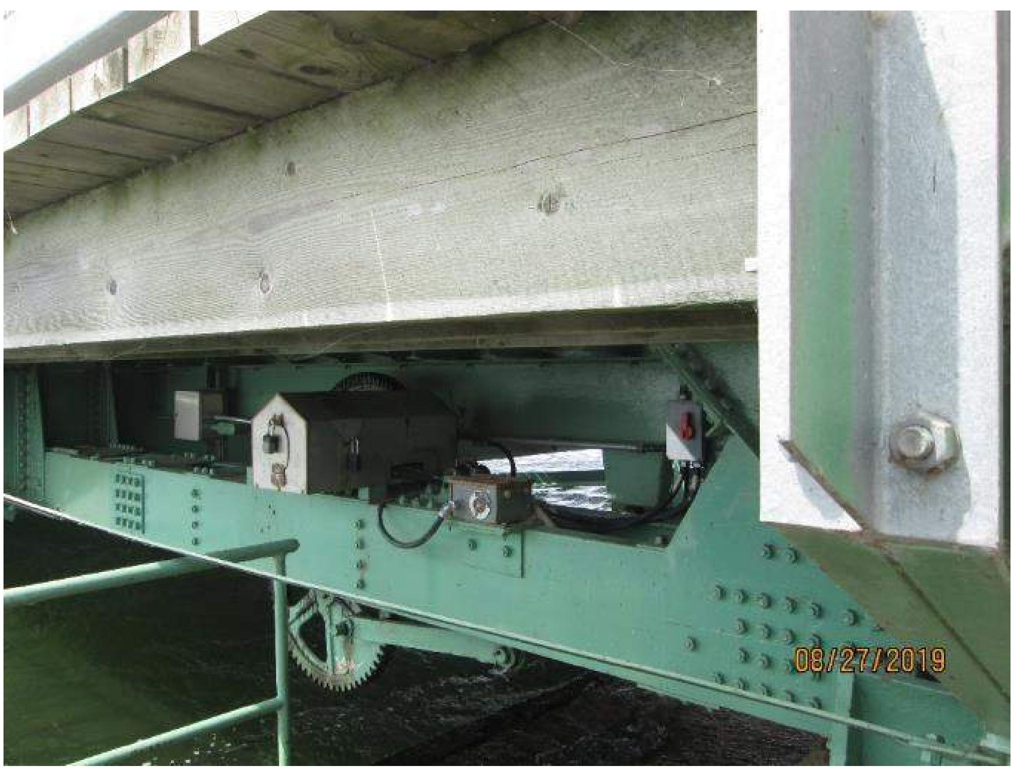


Photo E-16: Span Lock Motor, Rotary Cam Limit Switch (RCLS) and Disconnect Switch. The span lock motor is housed in a stainless steel enclosure and is provided with a local disconnect switch. The span lock is also provided with a two cam limit switch for control, interlock and indication during bridge operation. Note the minor corrosion on the RCLS enclosure.

Photo E-17: North Side Span Lock Rotary Cam Switch. The span lock is provided with a second RCLS to monitor the position of the north lock bar. The RCLS enclosure exhibit moderate signs of corrosion.

Photo E-18: Control Desk. The location of the control desk provides the operator with a complete view of the channel and vehicular and pedestrian roadway traffic. The control desk is in acceptable condition. Note the foot switch next to the control desk on the floor is in good operational condition.

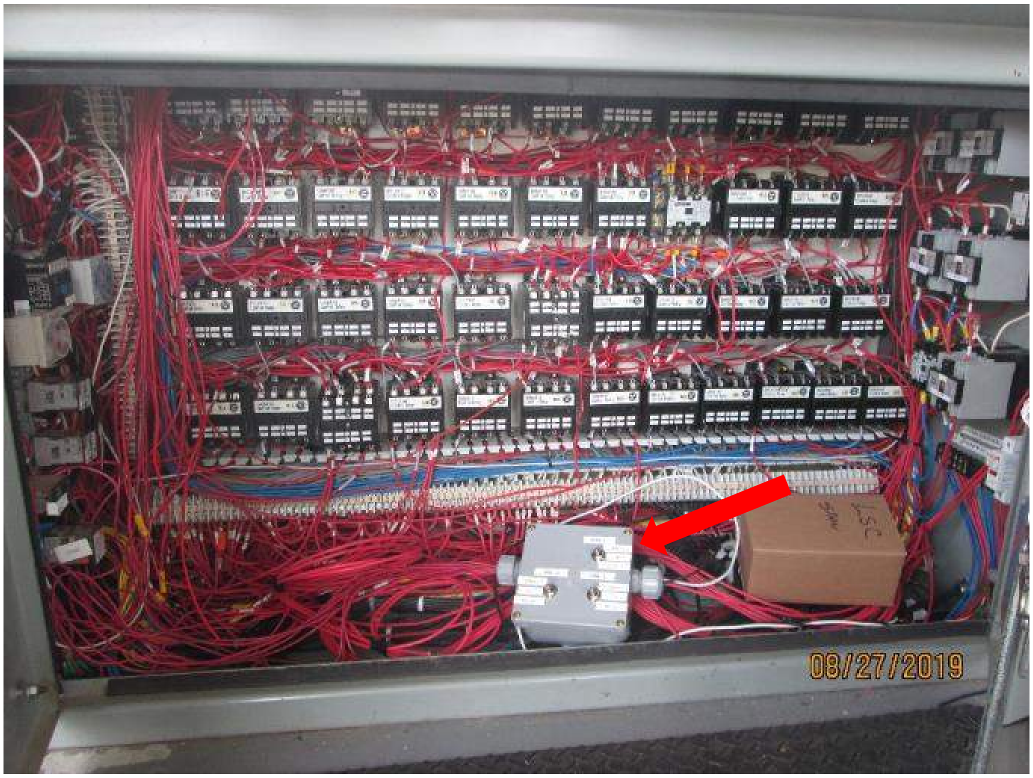


Photo E-19: Relay Control inside the Control Desk. This relay cabinet was modified during the drive/motor replacement project to accommodate the new control required for the new drive system. Note the toggle switch box is installed inside the cabinet to allow the bridge fully seated limit switch at the toe end of the bridge to be switches to the new lever switch installed in the cam switch box inside the machinery space as a backup when the water level is too high.

Photo E-20: Machinery Space Local E-Stop. This E-Stop switch is located near the machinery space entrance. It allows maintenance personnel to prevent or stop bridge operation when work is being performed in the machinery space.

Photo E-21: Span Fully Seated Limit Switch. Two span seated limit switches are provided at the toe end of the span, one at each corner. North seated limit switch exhibits standing water inside the enclosure. Note during high water level, water will get inside the switch enclosure and cause operational issues.

Photo E-22: Speed Switch Sensor. A Hall Effect speed switch was installed as part of a 2012 rehabilitation project to provide span position and motor speed indication on the operator's control desk. The speed switch sensor is in very good condition.

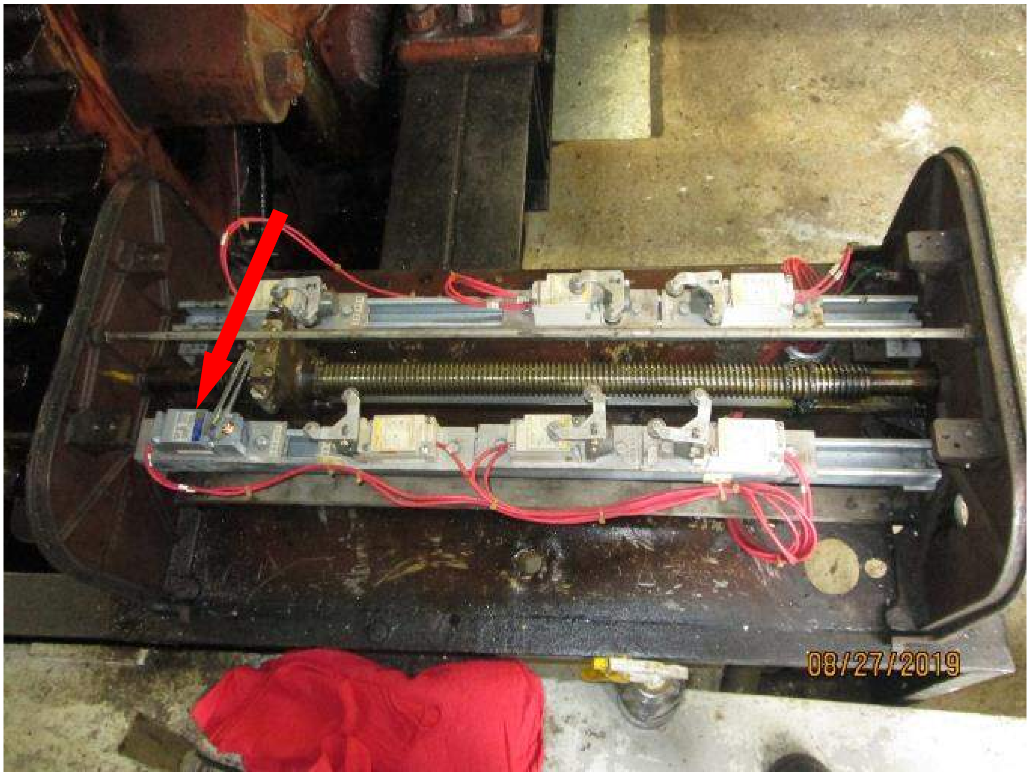


Photo E-23: Span Position Limit Switches. The targets on the auxiliary threaded shaft are used to toggle the lever type limit switches and provide discrete signals of the bridge position. The limit switch housing exhibits signs of corrosion, but the limit switches inside are in good operational condition. Note the added backup span seated limvit switch.

Photo E-24: Span Over-Travel Limit Switch. The span control is provided with an over-travel limit switch to stop bridge operation in the event of span over travel.

Photo E-25: Typical Traffic Signal (West Shown). Each bridge approach is provided with two sets of traffic signal fixtures mounted on cantilevered arms and suspended over the roadway. Additionally, a warning gong and a pedestrian signal light have been provided at each of the south traffic signal poles. The traffic signal equipment was installed as part of a recent rehabilitation project and is in very good condition. Note the east warning gong was not operational at the time of inspection.

Photo E-26: Typical Traffic Gate (Fully Raised). The bridge is provided with four (4) traffic gates, one at each approach to the span. All gates and gate arm lights were in good operational condition at the time of the inspection. Note the SW gate fully raised position is not adjust to the vertical position.

Photo E-27: Typical Traffic Gate Housing. The motor starter is located inside the gate housing. Note that no door limit switches have been provided to prevent gate operation when the gate door(s) are open for maintenance or troubleshooting but a sign has been installed to indicate that the gate is powered and should be disconnected at the MCC prior to maintenance being performed. Also note no hand crank limit switch has been provided in accordance with code.

Photo E-28: Typical Traffic Gate Limit Switches. The traffic gates are provided with a cam type limit switch. Although these limit switches were in operational condition at the time of the inspection, they are missing protective covers, switch contacts exhibit excessive corrosions due to the exposure which might cause premature failure.

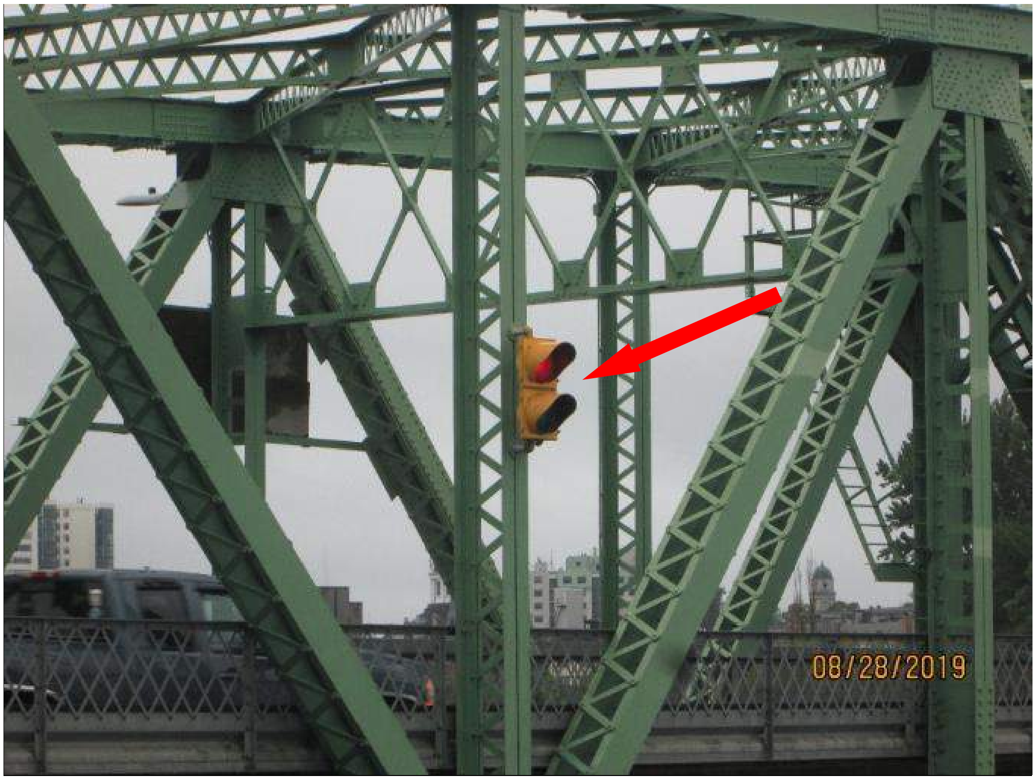


Photo E-29: Typical Span Navigation Light. Note that roadway type lights are being used. The location of the navigation lights does not provide marine traffic with a clear visual indication as to when the span has been raised and it is safe to proceed.

Photo E-30: Typical Fender Light. The bridge is provided with 4 fender light fixtures, one at each corner of the fender. The north fender lights are flash red and the south fender lights are flash green. The fender lights are of LED type and are in good operational condition.

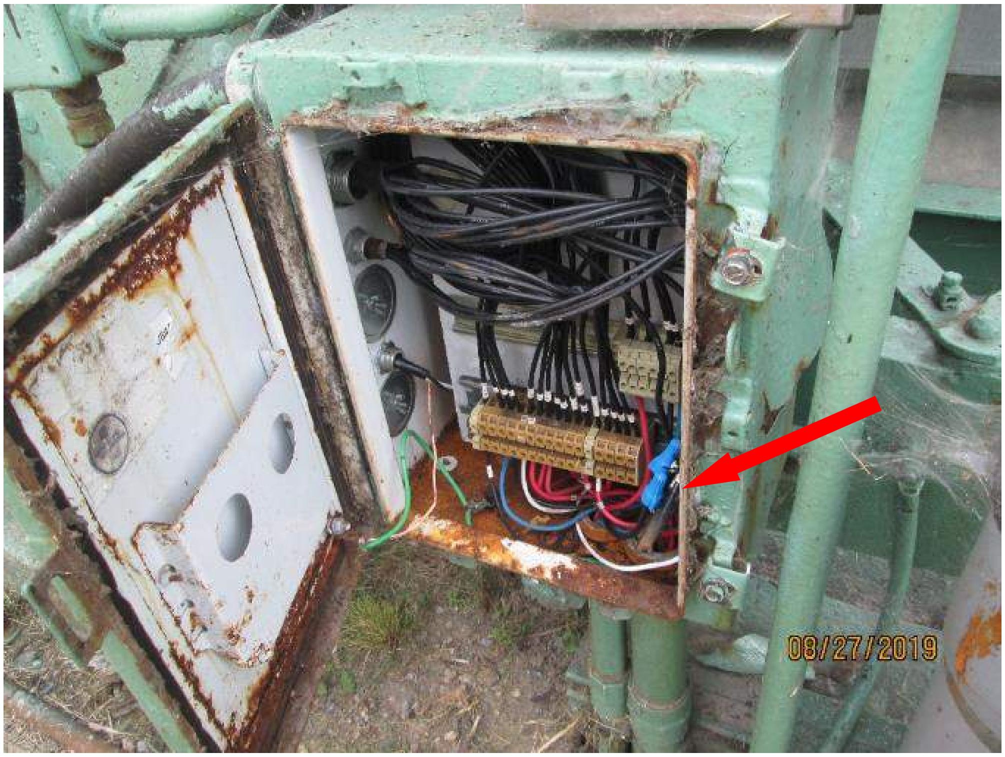


Photo E-31: Typical Outdoor Junction Box. Many of the outdoor junction/pull boxes are NEMA 4X boxes. Note this junction box exhibit heavy signs of corrosion at the bottom of the enclosure, also note the use of wire-nuts inside of inside the junction box. This junction box is in poor condition and is located at the bottom of the staircase leading to the machinery space.

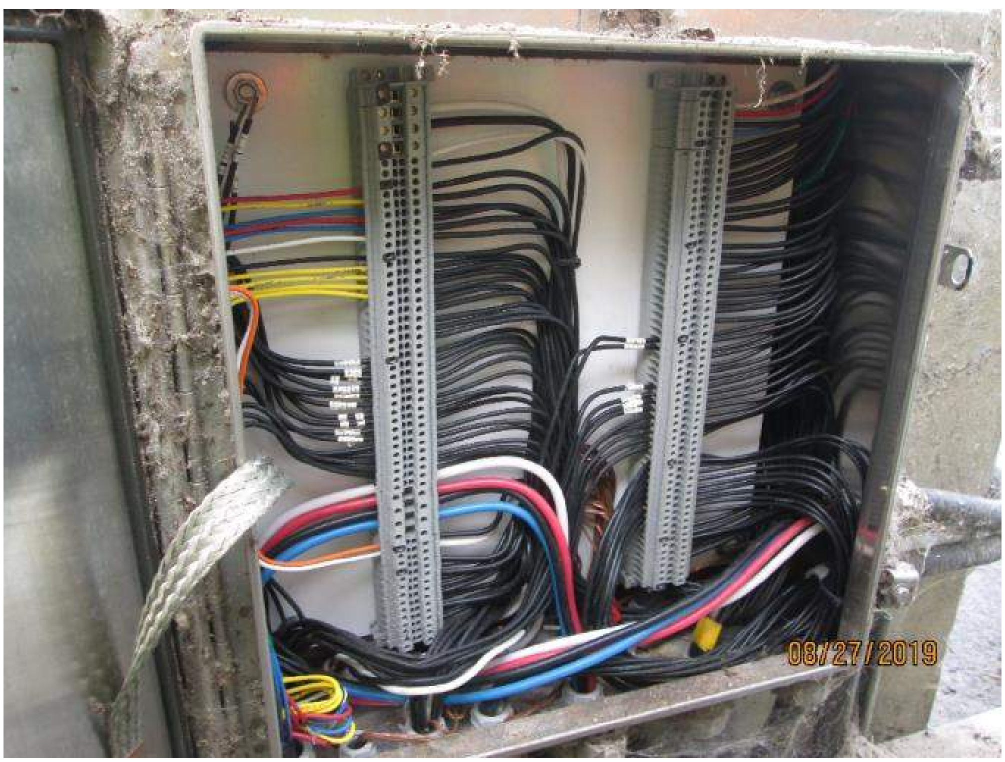


Photo E-32: Typical Submarine Cable Junction Box. The submarine cable junction box is in good condition with proper grounding and bonding but covered with debris both internally and externally. Note the wires inside the submarine cable junction boxes are not properly labelled.

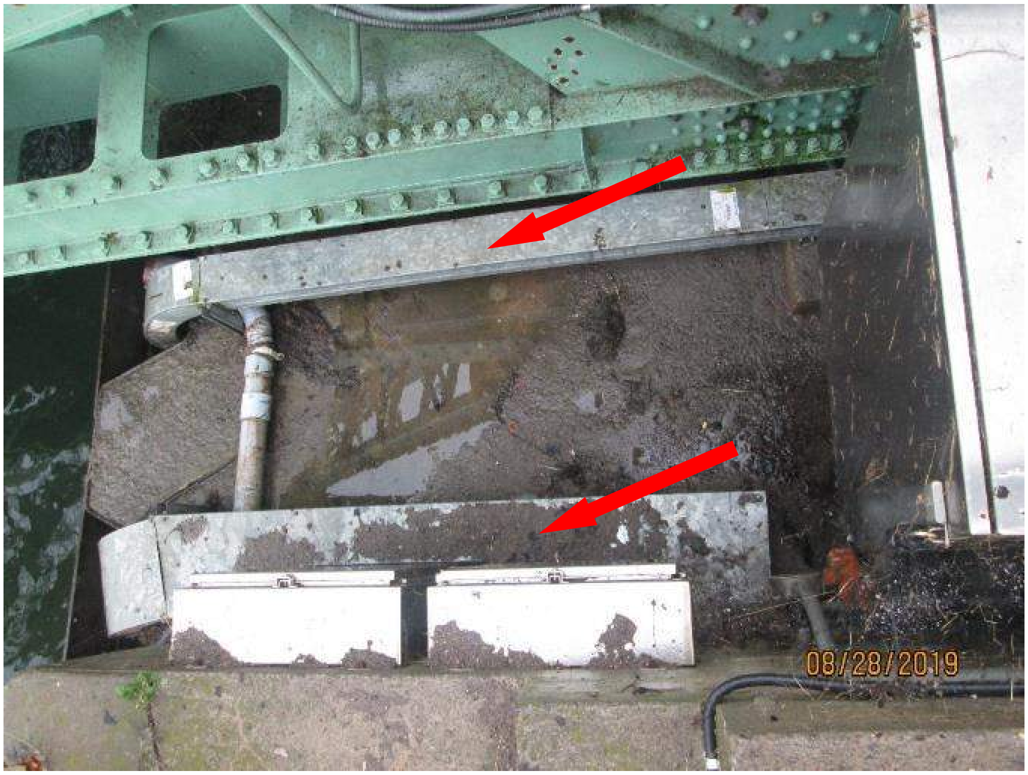


Photo E-33: Typical Submarine Power Cables. The submarine cable is used to carry control and power across the channel. Both recently installed and originally installed submarine cables were found at the bridge. It was unclear if the old submarine cable was abandoned or still in service. Note the new submarine cable is of the Teck cable type and is protected with wireways above water level on the pier.

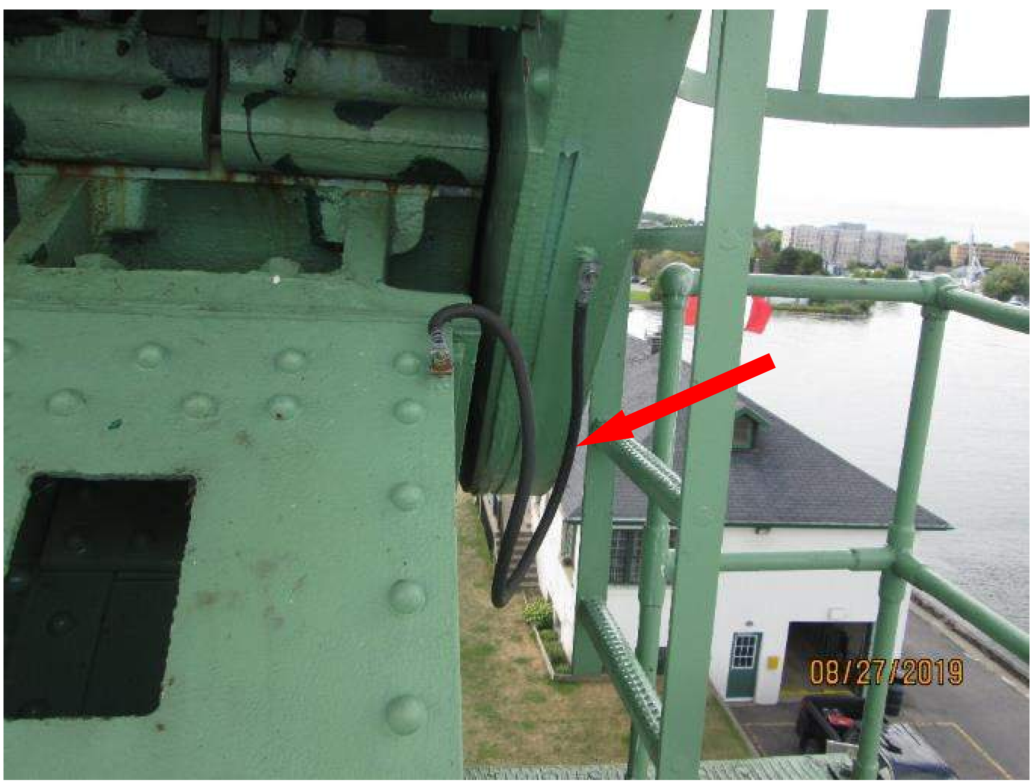


Photo E-34: Bridge Grounding & Bonding System. The bridge steel structures are provided with proper grounding and bonding system in accordance with code.

Photo E-35: Fire Alarm System. The bridge is equipped with a fire alarm system. Fire detection devices are provided in the bridge maintenance building, the bridge control house and machinery space. The main fire alarm control panel is located in the bridge maintenance facility with a remote annunciator located in the bridge operators control house. All fire alarm equipment was in good serviceable condition at the time of the inspection.

Photo E-36: General and Emergency Lighting. The lighting in the operator’s control house provides sufficient illumination level for both operation and maintenance and is in good working condition. The emergency lights were tested at the time of inspection and are operational.

Photo E-37: Machinery Space Lighting. The machinery space is provided with T5 light fixtures. These fixtures are in excellent operational condition and provide adequate lighting levels for maintenance and troubleshooting.

Photo E-38: CCTV System and Roadway Lighting. A CCTV system was installed at the bridge for monitoring of the bridge roadway, waterway and machinery space from the maintenance facility and the operators control house. The CCTV installation is in excellent condition. LED type roadway lighting are provided on the bridge and are photocell controlled.

Photo E-39: General Indoor Electrical Installation (Machinery Space Shown). Indoor electrical raceway installation in the machinery space and operators control house generally consists of rigid steel conduits. These conduits are in good condition. The bridge cable installation consists of wire in conduit and with Teck cables that were recently installed to feed the new drive motors.

Photo E-40: General Outdoor Installation. The bridge outdoor installation generally consists of Teck cable, painted RGS conduits, and stainless steel junction boxes. The installation is generally in good serviceable condition but with some of the cable/conduit support brackets exhibiting moderate signs of corrosion. The junction box at the bottom of the staircase leading to the machinery space is in poor condition.

APPENDIX F – COUNTERWEIGHT MEMORANDUM

1223 Michael Street North, Suite 100 | Ottawa, ON K1J 7T2
P: +1 613.738.4160 | F: +1 613.739.7105 | www.parsons.com

November 12, 2019

Ranya El Sadawy, P.Eng.
Public Services and Procurement Canada
11 Laurier Street
Gatineau, Quebec K1A 0S5

Subject: LaSalle Causeway Counterweight Memorandum

Dear Ranya,

The following is a Counterweight Memorandum as part of the LaSalle Causeway 2019 Comprehensive Detailed Annual Inspection (CDI) project for the LaSalle Causeway in Kingston, Ontario. The CDI was completed in accordance with Public Services and Procurement Canada (PSPC) Standing Offer EQ754-161365/001/PWL, Project Number R.090045.001.

Introduction

The Lasalle Causeway crossing consists of three bridge structures, a causeway, and ancillary structures and facilities. Due to abnormally high-water levels the CDI field work was scheduled in two phases, with Phase 1 generally including topside work and Phase 2 generally including water-based access and diving operations. Phase 1 was completed Wednesday August 14 to Friday August 16, 2019. Phase 2 was completed Wednesday October 23 to Friday October 25, 2019.

The CDI included visual inspection of the counterweight's visible elements. Through prior inspections it was noted that the sheet metal angles at the base of the counterweight cladding were retaining some disintegrated concrete and other deleterious loose debris. Should the CDI confirm a sizeable quantity of debris was present, our proposal included a provisional item to remove the angles to facilitate removal of the loose debris.

Observations

For the CDI access to the counterweight, other than the top surface, was via a self-propelled diesel operated manlift. Access to the top surface was via rope access.

Through inspection of the counterweight lower angle area, specifically the gap between the sheet metal cladding and counterweight, we observed varying amounts of debris bearing on the angles and soffit cladding. Comparatively, the north east area had the most amount of debris with the remaining areas having less to slightly less debris. All areas had some amount of debris.

We determined that the amount of debris warranted removal to reduce the risk of material falling onto the roadway below. We recommended activating the provisional item for removal of debris which was then approved by PSPC.

Concrete Removal

Removal of the debris was completed starting at 10:00 pm Wednesday October 30 and ending at 6:00 am Thursday October 31, 2019. Removal of the angles and debris was completed by GA Wright & Son. Single lane closures were provided by Beacon Lite. Parsons and PSPC were on site to observe the work, and a bridge operator was also present.

The work started at the south west corner and proceeded counterclockwise. The sheet metal cladding screw heads had a plastic cap that would break when a wrench was applied to remove them. The first alternative for removal was to grind off the heads, then a second more efficient method was to shear off the heads off with a chisel and hammer. Sometimes a vise grip was used to turn some of the screws. New self-tapping screws were installed when re-fastening the cladding. On the west and east side soffit there is a sheet metal hat section member about 0.5 meter in from the face running north south that the soffit cladding is fastened to. The top of the hat is fastened to the counterweight, and the hat legs are on the bottom fastened to the cladding. This section provides a gap between the counterweight and the cladding.

Debris was removed manually and using a pry bar and various tools. Debris, if present, was not removed beyond the hat section members as access was not possible without removing all the soffit cladding. However, based on very limited viewing beyond the hat section members via the cladding corrugations it did not appear there was excessive debris beyond those members. In some areas, if the side cladding was impacted debris would fall from within the gap. The debris was deposited into buckets and then transferred into the bed of a GA Wright pickup truck.

As observed during the CDI, the north east area had the most amount of debris with the remaining areas having less to slightly less debris, with all areas having some amount of debris. The north east area also had the most observed concrete section loss, with the corner area having the most loss which extended up approximately 300 mm. The debris appeared to consist of disintegrated concrete, aggregate, and possibly some organics as evidenced by blackish soil looking material. The organic looking material was generally located towards the south end of the counterweight on both the east and west sides. All the material was damp. A guestimate of the weight of material removed was in the 45 to 70 kg (100 to 150 lb.) range. See Photo 1.

Where visible the counterweight concrete was generally in poor condition exhibiting disintegration, spalling, efflorescence with and without stalactites and stalagmites. See Photo 2. There were areas of exposed and corroding reinforcing steel and wire mesh. The reinforcing steel bars were round, not deformed, which is reflective of the vintage of the structure. See Photo 3.

The two north east and south east facing access doors were opened to observe the interior space which was an empty chamber. The south east chamber concrete was sounded with a hammer, many areas were hollow or soft sounding, i.e. deep concrete disintegration, particularly on the south face, the soffit had pattern and alligator cracking with efflorescence and stalactites, and the floor had the best sounding concrete. See Photo 4. The north east chamber concrete was sounded with a hammer, some areas were hollow or soft sounding, i.e. deep concrete disintegration, particularly on the south face, the soffit had pattern and alligator cracking with efflorescence and stalactites, and the floor had the best sounding concrete. Overall, the concrete in the north space was in slightly better condition than the south space. Both hatch doors needed to be wedged into place to be closed, the hinges are loose and in poor condition.

2018 Bascule Bridge CDI Report (DRAFT)

With regard to the condition of the concrete, the 2018 CDI included obtaining concrete cores from the counterweight for observation and testing. A Draft report dated February 2019 has been submitted to PSPC for review. The concrete coring was completed by Capital Cutting and Coring and testing completed by Gemtec Consulting Engineers and Scientists. Gemtec’s report dated November 2018 is appended to the 2019 CDI report.

A total of six 100 mm diameter cores ranging in depth from 126 mm to 611 mm were taken from the east and west faces. The average depth of the six cores was 320 mm. Due to the poor quality of the concrete in the cores extracted it was only possible to test a single core sample for compressive strength, Core #2, which was obtained from the west face, north end, top. The result indicated a compressive strength of 11.9 MPa at an approximate depth of 50 to 255 mm. Based on the MTO Structure Rehabilitation Manual, structural concrete with compressive strengths under 20 MPa is of poor quality. In general, and in relation to the core locations, the edges and particularly the lower portions of the counterweight are in poor condition, with the exception of Core #2 located in the upper region. See Figure 1.

Photo 1 Debris - Removed

Photo 2 Soffit - Efflorescence, Stalactites, Stalagmites, Typ.

Photo 3 Soffit – South East Region

Photo 4 Chamber - South East

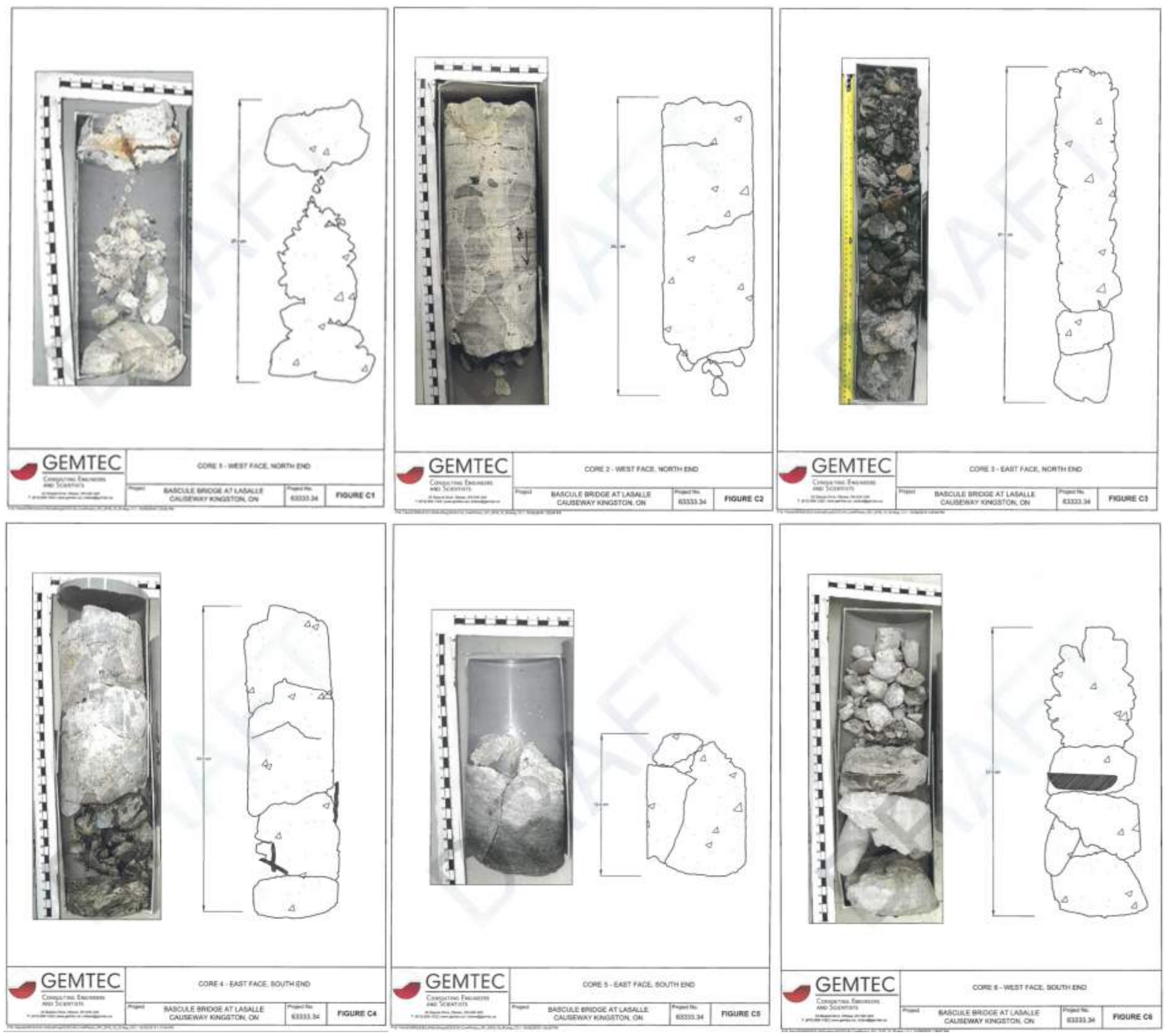


Figure 1 Cores – Core # 1 to 6 Cross Sections

Summary of Observations

Observations from previous inspections and testing, the current 2019 CDI, and during the recent concrete removal all indicate that the concrete is generally in poor condition. It appears the concrete is in slightly better condition in the upper regions and increases in degradation towards the lower regions. There is an unknown with regard to the condition of the concrete within the counterweight mass. The six cores taken in 2018 had an average depth of 320 mm. The chambers provide a view into the mass but only offer a visual indicator through the condition of the chamber surfaces.

Considering the condition of the concrete, particularly in the lower regions, and with degradation that is continuing and possibly accelerating, there is an increasing risk that a portion or portions of concrete can break away from the mass. The concrete is reinforced with round bar reinforcing steel and wire mesh that provide some containment, but those elements are also degrading through corrosion and are in a weakened state.

From available drawings it appears there are three triangular shaped steel frames spanning east west within the counterweight that provide structure and support for the concrete. The drawings are dated and may not fully reflect the current configuration of the counterweight; however, they are likely indicative of the general structure. See Figure 2.

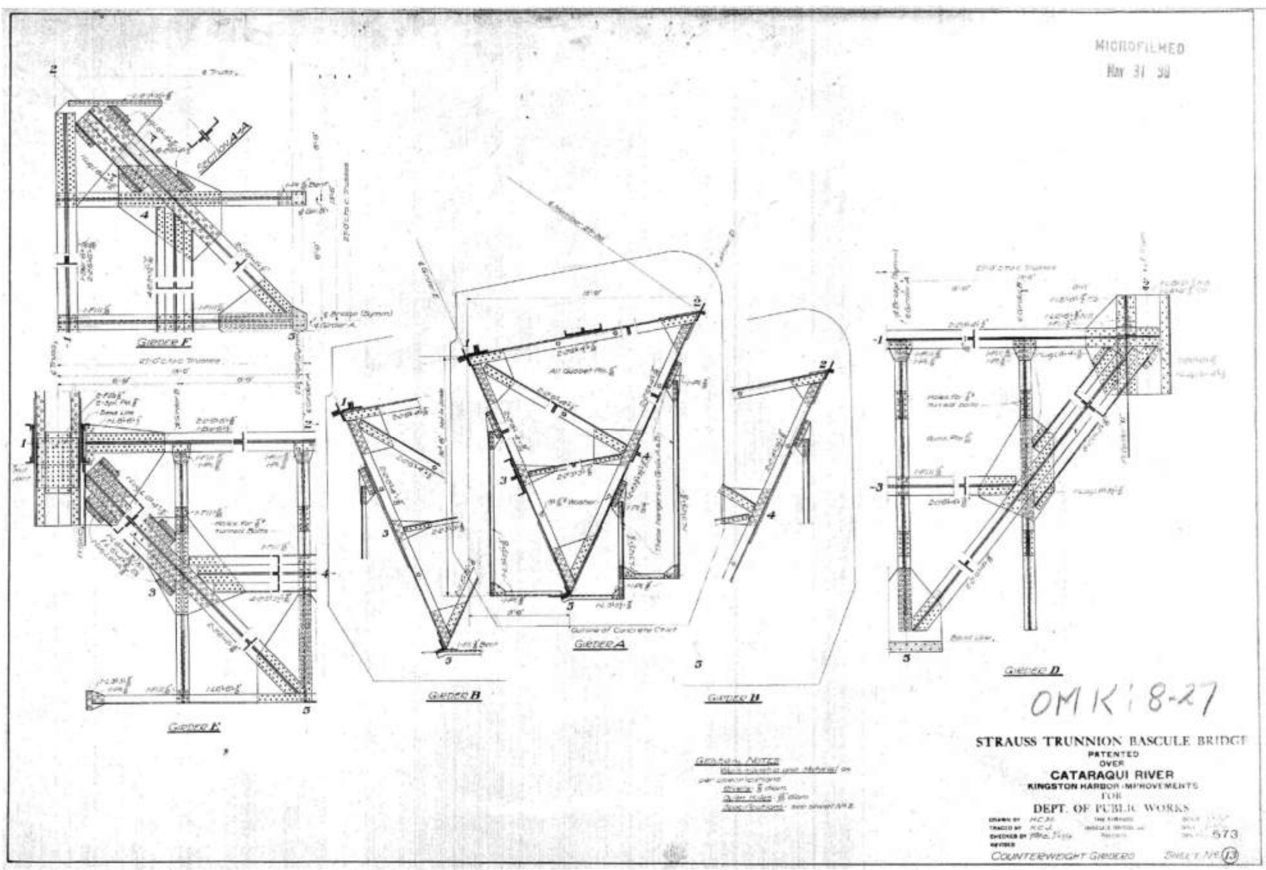


Figure 2 Counterweight Structural Steel

Recommendations

Based on current and past observations of continuing degradation of the counterweight concrete, and with an increasing risk that a portion or portions of concrete can break away from the mass, we recommend further investigations to enable the determination of short and long-term remedial strategies.

The following provides a framework of recommendations for discussion and consideration;

1. Investigation; Build on the existing inspection and condition survey data via obtaining additional concrete deep cores to provide insights into the condition of the interior mass of the counterweight. The cores should be of relatively small diameter, in the 50 mm range, to reduce the risk of intersecting or damaging internal reinforcing steel and other structural elements. The cores should extend to approximately the centre of the counterweight if taken from the east and west faces, or full depth if taken from one face. Coring procedures should be confirmed with a provider(s) of this service as part of the investigation planning.

   As the three triangular shaped steel frames (Girders A and B in the original design drawings) span east west within the counterweight, it follows that the cores should be taken in an east west direction, but care needs to be taken to avoid the two inclined steel frames (Girders D and E in the original design drawings) that span north-south. There are also numerous threaded rods running north-south to be considered. A mapping exercise based on existing drawings to document the internal structure is recommended to aid in determining suitable core locations.

   Schedule; This work can potentially be scheduled during the winter to spring months of 2019-2020 depending on weather conditions, etc. Operations would be configured for cold weather work. The voids left by coring operations could have the open end(s) plugged, or suitable cold weather grout could be used to fill the voids in their entirety.

2. Short Term; Depending on the results of the coring, remove the cladding to inspect the concrete. Remove loose material within reasonable limits, complete necessary localized repairs, and “wrap” the counterweight to provide temporary additional support to the concrete. Considering the sensitivity of the structure to weight distribution to remain balanced, this could be achieved using lightweight advanced composite materials such as glass or carbon fiber sheets.

   Schedule; Depending on the results of the investigation, this work could be considered for completion during the upcoming trunnion rehabilitation. The work could also be coordinated with the deck replacement that is currently being studied or scheduled independently of other works. However, the schedule should consider that time is of the essence with the increasing risks associated with the continuing counterweight deterioration.

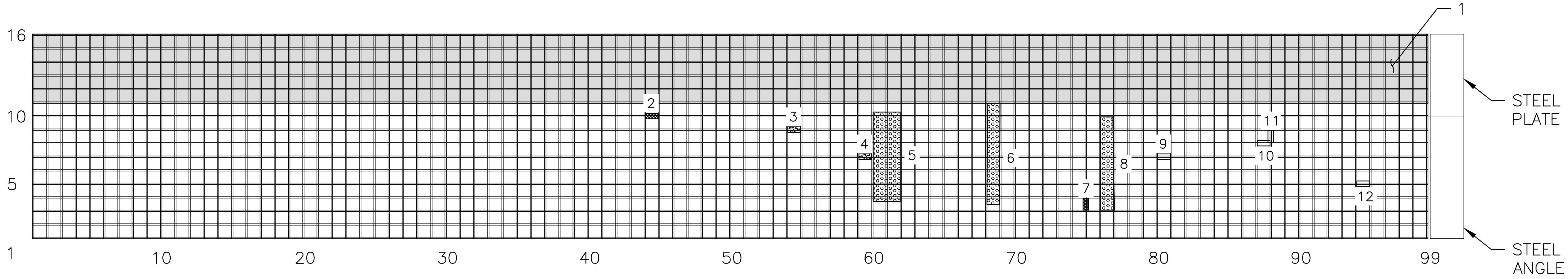
3. Long term; The results of the recent CDI’s, further investigation via deep cores, and removal of the cladding would then provide a basis for determination of long-term remedial strategies. These could include major rehabilitation or replacement.

   Schedule; The schedule would be dependent on a number of factors such as condition of the counterweight, scheduling of other works, life span of short-term works, budgeting, etc.

Sincerely,

(Brian Wood)

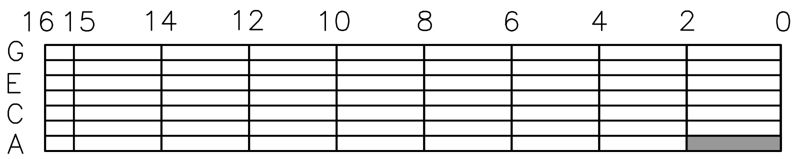
APPENDIX G – DECK GRATING INSPECTION DRAWINGS



0-2 - A

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS		
2	BENT LONGITUDINAL BAR		
3	BROKEN LONGITUDINAL BAR		
4	BROKEN LONGITUDINAL BAR		
5	DEBRIS		
6	DEBRIS		
7	BROKEN TRANSVERSE BAR		
8	DEBRIS		
9	STEEL BAR REPAIR		
10	STEEL BAR REPAIR		
11	STEEL BAR REPAIR		
12	STEEL BAR REPAIR		
13			
14			
15			



GSC-A3A 95-09

Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

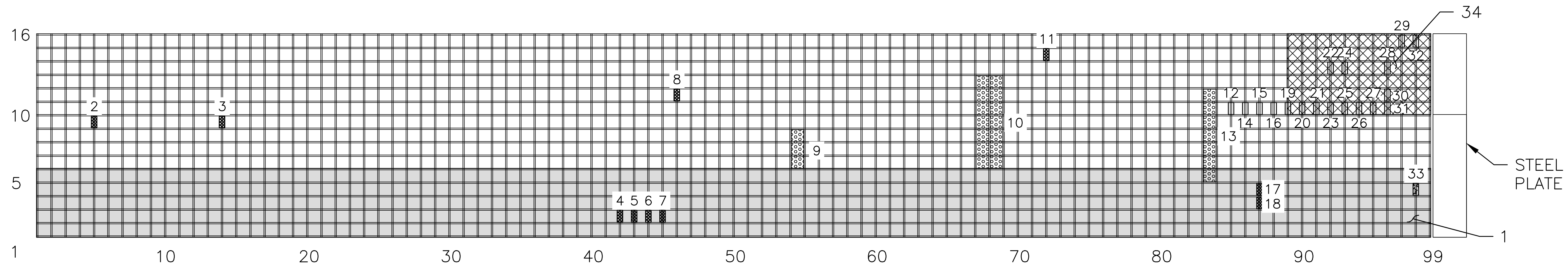
DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets
FEBRUARY 2021	project date / date du projet
R.090045.001	project no. / no. du projet
01 OF 65	drawing no. / dessine no.

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

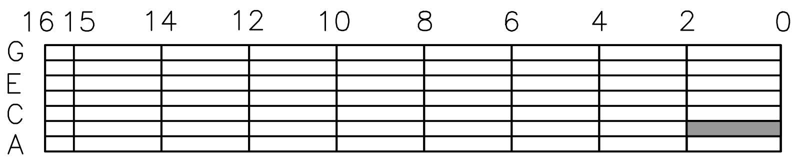
DATE PLOTTED: Monday, February 22, 2021 9:32:23 AM



0–2 – B

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	16	STEEL BAR REPAIR	31	STEEL BAR REPAIR
2	BENT TRANSVERSE BAR	17	BENT TRANSVERSE BAR	32	STEEL BAR REPAIR
3	BENT TRANSVERSE BAR	18	BENT TRANSVERSE BAR	33	BROKEN TRANSVERSE BAR
4	BENT TRANSVERSE BAR	19	STEEL BAR REPAIR	34	SEVERELY BENT AND BROKEN TRANSVERSE BARS
5	BENT TRANSVERSE BAR	20	STEEL BAR REPAIR		
6	BENT TRANSVERSE BAR	21	STEEL BAR REPAIR		
7	BENT TRANSVERSE BAR	22	STEEL BAR REPAIR		
8	BENT TRANSVERSE BAR	23	STEEL BAR REPAIR		
9	DEBRIS	24	STEEL BAR REPAIR		
10	DEBRIS	25	STEEL BAR REPAIR		
11	BENT TRANSVERSE BAR	26	STEEL BAR REPAIR		
12	STEEL BAR REPAIR	27	STEEL BAR REPAIR		
13	DEBRIS	28	STEEL BAR REPAIR		
14	STEEL BAR REPAIR	29	STEEL BAR REPAIR		
15	STEEL BAR REPAIR	30	STEEL BAR REPAIR		



GSC-A3A 95-09

Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par

SW — designed by / conc par

PH — approved by / approuve par

tender / soumission — project manager / administrateur de projets

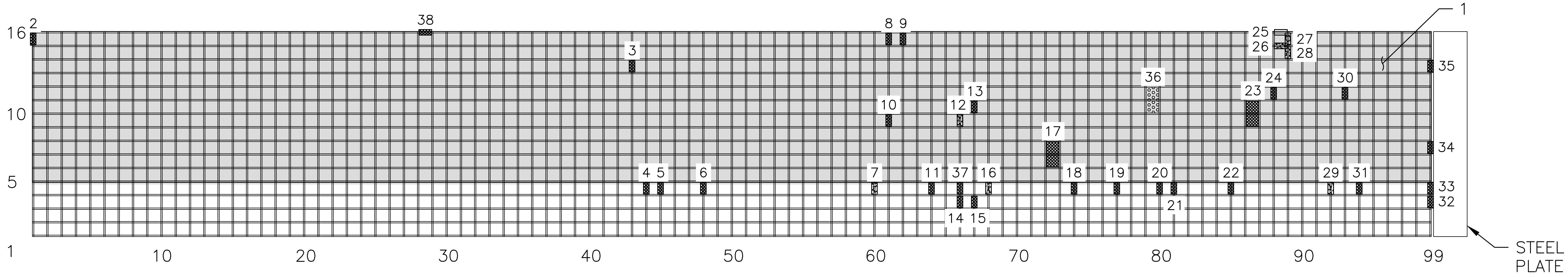
FEBRUARY 2021 — project date / date du projet

R.090045.001 — project no. / no. du projet

02 OF 65 — drawing no. / dessine no.

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

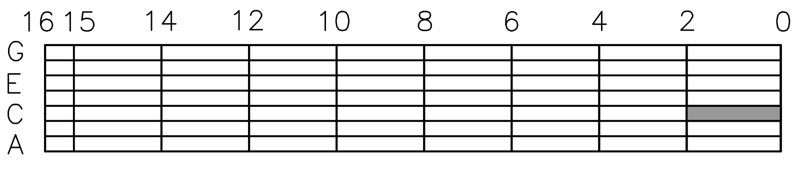
DATE PLOTTED: Monday, February 22, 2021 9:32:27 AM



0–2 – C

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	16	BENT TRANSVERSE BAR	31	BENT TRANSVERSE BAR
2	BROKEN TRANSVERSE BAR	17	BROKEN/BENT BARS & DEBRIS	32	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR	18	BENT TRANSVERSE BAR	33	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR	19	BENT TRANSVERSE BAR	34	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR	20	BENT TRANSVERSE BAR	35	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR	21	BENT TRANSVERSE BAR	36	DEBRIS
7	BROKEN TRANSVERSE BAR	22	BENT TRANSVERSE BAR	37	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR	23	BENT/BROKEN BARS & DEBRIS	38	CRACKED WELD AT SILL
9	BENT TRANSVERSE BAR	24	BENT TRANSVERSE BAR		
10	BENT TRANSVERSE BAR	25	STEEL BAR REPAIR		
11	BENT TRANSVERSE BAR	26	BROKEN LONGITUDINAL BAR		
12	BROKEN TRANSVERSE BAR	27	BROKEN TRANSVERSE BAR		
13	BENT TRANSVERSE BAR	28	BROKEN TRANSVERSE BAR		
14	BROKEN TRANSVERSE BAR	29	BROKEN TRANSVERSE BAR		
15	BENT TRANSVERSE BAR	30	BENT TRANSVERSE BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par

SW — designed by / conc par

PH — approved by / approuve par

tender soumission — project manager administrateur de projets

FEBRUARY 2021 — project date / date du projet

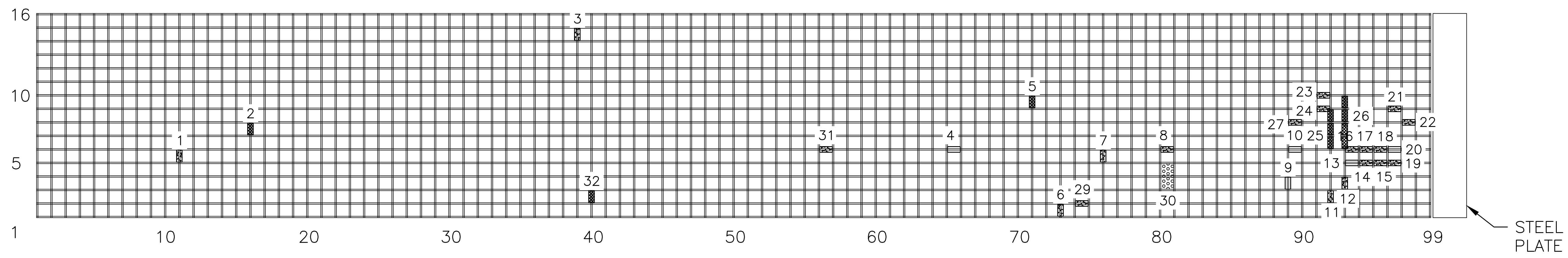
R.090045.001 — project no. / no. du projet

03 OF 65 — drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

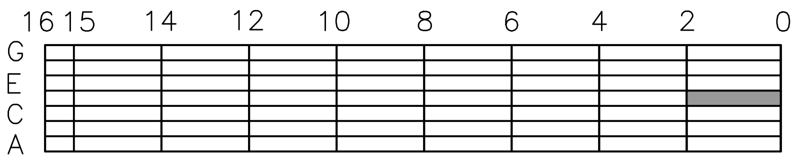
DATE PLOTTED: Monday, February 22, 2021 9:32:32 AM



O-2 - D

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	BROKEN TRANSVERSE BAR	16	BROKEN LONGITUDINAL BAR	31	BROKEN LONGITUDINAL BAR
2	BENT TRANSVERSE BAR	17	BROKEN LONGITUDINAL BAR	32	BROKEN TRANSVERSE BAR
3	BROKEN TRANSVERSE BAR	18	BROKEN LONGITUDINAL BAR		
4	FIXED STEEL BAR	19	BENT LONGITUDINAL BAR		
5	BENT TRANSVERSE BAR	20	FIXED STEEL BAR		
6	BROKEN TRANSVERSE BAR	21	BROKEN LONGITUDINAL BAR		
7	BROKEN TRANSVERSE BAR	22	BROKEN LONGITUDINAL BAR		
8	BROKEN LONGITUDINAL BAR	23	FIXED LONGITUDINAL BAR		
9	FIXED STEEL BAR	24	FIXED LONGITUDINAL BAR		
10	FIXED STEEL BAR	25	BROKEN TRANSVERSE BAR x 3		
11	BROKEN TRANSVERSE BAR	26	BROKEN TRANSVERSE BAR x 4		
12	BROKEN TRANSVERSE BAR	27	BROKEN LONGITUDINAL BAR		
13	FIXED STEEL BAR	28	SERRATIONS x 2		
14	BROKEN LONGITUDINAL BAR	29	BROKEN LONGITUDINAL BAR		
15	BROKEN LONGITUDINAL BAR	30	DEBRIS		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

BRIDGE GRATING DETERIORATIONS

TN
drawn by — dessine par

SW
designed by — conc par

PH
approved by — approuve par

tender soumission — project manager administrateur de projets

FEBRUARY 2021
project date — date du projet

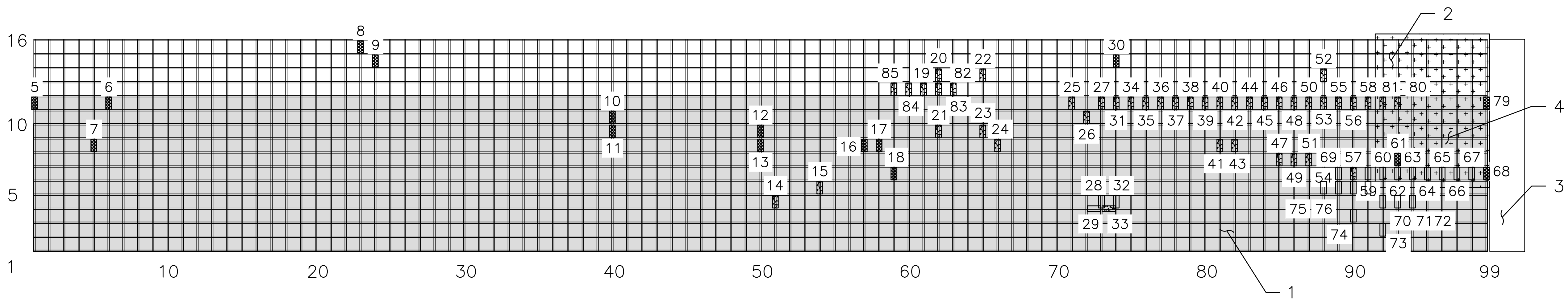
R.090045.001
project no. — no. du projet

04 OF 65
drawing no. — dessine no.

GSC-A3A 95-09

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

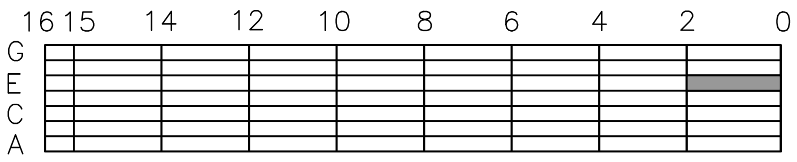
DATE PLOTTED: Monday, February 22, 2021 9:32:37 AM



0–2 — E

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	20	BROKEN TRANSVERSE BAR	39	BROKEN TRANSVERSE BAR	58	BROKEN TRANSVERSE BAR	77	BROKEN TRANSVERSE BAR
2	TEMPORARY STEEL PLATE	21	BROKEN TRANSVERSE BAR	40	BROKEN TRANSVERSE BAR	59	STEEL BAR REPAIR	78	BENT TRANSVERSE BAR
3	MISSING STEEL PLATE	22	BROKEN TRANSVERSE BAR	41	BROKEN TRANSVERSE BAR	60	STEEL BAR REPAIR	79	BENT TRANSVERSE BAR
4	LONGITUDINAL AND TRANSVERSE BARS MISSING	23	BROKEN TRANSVERSE BAR	42	BROKEN TRANSVERSE BAR	61	BENT TRANSVERSE BAR	80	BROKEN TRANSVERSE BAR
5	BENT TRANSVERSE BAR	24	BROKEN TRANSVERSE BAR	43	BROKEN TRANSVERSE BAR	62	STEEL BAR REPAIR	81	BROKEN TRANSVERSE BAR
6	BENT TRANSVERSE BAR	25	BROKEN TRANSVERSE BAR	44	BROKEN TRANSVERSE BAR	63	STEEL BAR REPAIR	82	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR	26	BROKEN TRANSVERSE BAR	45	BROKEN TRANSVERSE BAR	64	STEEL BAR REPAIR	83	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR	27	BROKEN TRANSVERSE BAR	46	BROKEN TRANSVERSE BAR	65	STEEL BAR REPAIR	84	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR	28	STEEL BAR REPAIR	47	BROKEN TRANSVERSE BAR	66	STEEL BAR REPAIR	85	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR	29	STEEL BAR REPAIR	48	BROKEN TRANSVERSE BAR	67	STEEL BAR REPAIR	86	EXT. BAR BENT
11	BENT TRANSVERSE BAR	30	BENT TRANSVERSE BAR	49	BROKEN TRANSVERSE BAR	68	BENT TRANSVERSE BAR		
12	BENT TRANSVERSE BAR	31	BROKEN TRANSVERSE BAR	50	BROKEN TRANSVERSE BAR	69	BROKEN TRANSVERSE BAR		
13	BENT TRANSVERSE BAR	32	STEEL BAR REPAIR	51	BROKEN TRANSVERSE BAR	70	BENT TRANSVERSE BAR		
14	BROKEN TRANSVERSE BAR	33	BROKEN LONGITUDINAL BAR	52	BROKEN TRANSVERSE BAR	71	BENT TRANSVERSE BAR		
15	BROKEN TRANSVERSE BAR	34	BROKEN TRANSVERSE BAR	53	BROKEN TRANSVERSE BAR	72	BENT TRANSVERSE BAR		
16	BENT TRANSVERSE BAR	35	BROKEN TRANSVERSE BAR	54	BROKEN TRANSVERSE BAR	73	BROKEN TRANSVERSE BAR		
17	BENT TRANSVERSE BAR	36	BROKEN TRANSVERSE BAR	55	BROKEN TRANSVERSE BAR	74	BENT TRANSVERSE BAR		
18	BENT TRANSVERSE BAR	37	BROKEN TRANSVERSE BAR	56	BROKEN TRANSVERSE BAR	75	BROKEN TRANSVERSE BAR		
19	BROKEN TRANSVERSE BAR	38	BROKEN TRANSVERSE BAR	57	BROKEN TRANSVERSE BAR	76	BROKEN TRANSVERSE BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

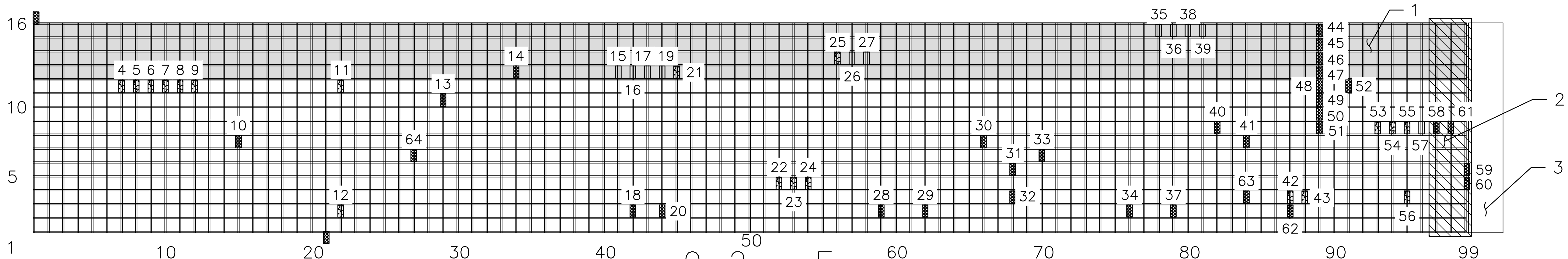
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	05 OF 65 — drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

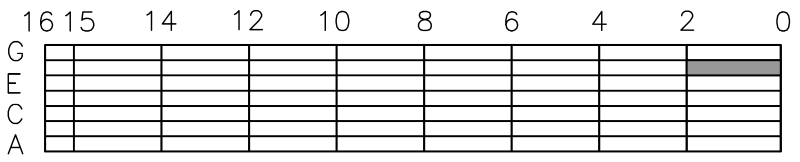
DATE PLOTTED: Monday, February 22, 2021 9:32:43 AM



O-2 – F

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	22	BROKEN TRANSVERSE BAR	43	BROKEN TRANSVERSE BAR	64	BENT TRANSVERSE BAR
2	AREA OF BROKEN TRANSVERSE BARS	23	BROKEN TRANSVERSE BAR	44	BENT TRANSVERSE BAR	65	EXTERIOR BAR BENT
3	MISSING STEEL PLATE	24	BROKEN TRANSVERSE BAR	45	BENT TRANSVERSE BAR	66	EXTERIOR BAR BENT/MISALIGNED
4	BROKEN TRANSVERSE BAR	25	BROKEN TRANSVERSE BAR	46	BENT TRANSVERSE BAR		
5	BROKEN TRANSVERSE BAR	26	STEEL BAR REPAIR	47	BENT TRANSVERSE BAR		
6	BROKEN TRANSVERSE BAR	27	STEEL BAR REPAIR	48	BENT TRANSVERSE BAR		
7	BROKEN TRANSVERSE BAR	28	BENT TRANSVERSE BAR	49	BENT TRANSVERSE BAR		
8	BROKEN TRANSVERSE BAR	29	BENT TRANSVERSE BAR	50	BENT TRANSVERSE BAR		
9	BROKEN TRANSVERSE BAR	30	BENT TRANSVERSE BAR	51	BENT TRANSVERSE BAR		
10	BENT TRANSVERSE BAR	31	BENT TRANSVERSE BAR	52	BENT TRANSVERSE BAR		
11	BROKEN TRANSVERSE BAR	32	BENT TRANSVERSE BAR	53	BROKEN TRANSVERSE BAR		
12	BROKEN TRANSVERSE BAR	33	BENT TRANSVERSE BAR	54	BROKEN TRANSVERSE BAR		
13	BENT TRANSVERSE BAR	34	BENT TRANSVERSE BAR	55	BROKEN TRANSVERSE BAR		
14	BENT TRANSVERSE BAR	35	STEEL BAR REPAIR	56	BROKEN TRANSVERSE BAR		
15	STEEL BAR REPAIR	36	STEEL BAR REPAIR	57	STEEL BAR REPAIR		
16	STEEL BAR REPAIR	37	BENT TRANSVERSE BAR	58	BENT TRANSVERSE BAR		
17	STEEL BAR REPAIR	38	STEEL BAR REPAIR	59	BENT TRANSVERSE BAR		
18	BENT TRANSVERSE BAR	39	STEEL BAR REPAIR	60	BENT TRANSVERSE BAR		
19	STEEL BAR REPAIR	40	BENT TRANSVERSE BAR	61	BENT TRANSVERSE BAR		
20	BENT TRANSVERSE BAR	41	BENT TRANSVERSE BAR	62	BENT TRANSVERSE BAR		
21	BROKEN TRANSVERSE BAR	42	BROKEN TRANSVERSE BAR	63	BENT TRANSVERSE BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

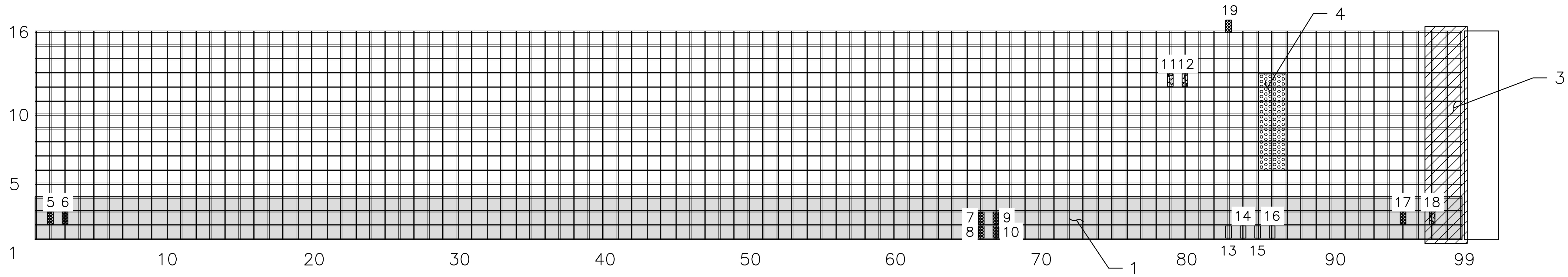
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	06 OF 65 — drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

GSC-A3A 95-09

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

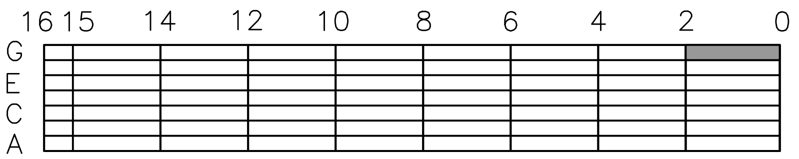
DATE PLOTTED: Monday, February 22, 2021 9:32:48 AM



0-2 - G

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	13	STEEL BAR REPAIR
2		14	STEEL BAR REPAIR
3	AREA OF BENT TRANSVERSE BARS	15	STEEL BAR REPAIR
4	DEBRIS	16	STEEL BAR REPAIR
5	BENT TRANSVERSE BAR	17	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR	18	BROKEN TRANSVERSE BAR
7	BENT TRANSVERSE BAR	19	EXTERIOR BAR BENT
8	BENT TRANSVERSE BAR		
9	BENT TRANSVERSE BAR		
10	BENT TRANSVERSE BAR		
11	BROKEN TRANSVERSE BAR		
12	BROKEN TRANSVERSE BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

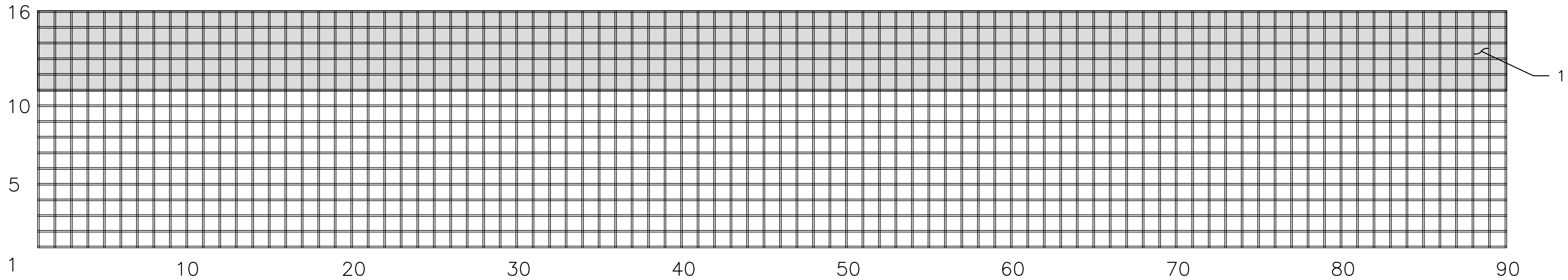
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	
tender soumission / project manager administrateur de projets	07 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: \\xccan57fs01\data\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 0-2.dwg

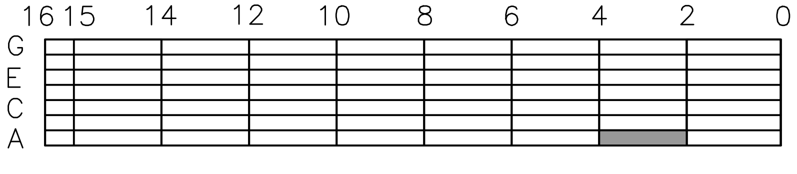
DATE PLOTTED: Monday, February 22, 2021 9:32:55 AM



2–4 – A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

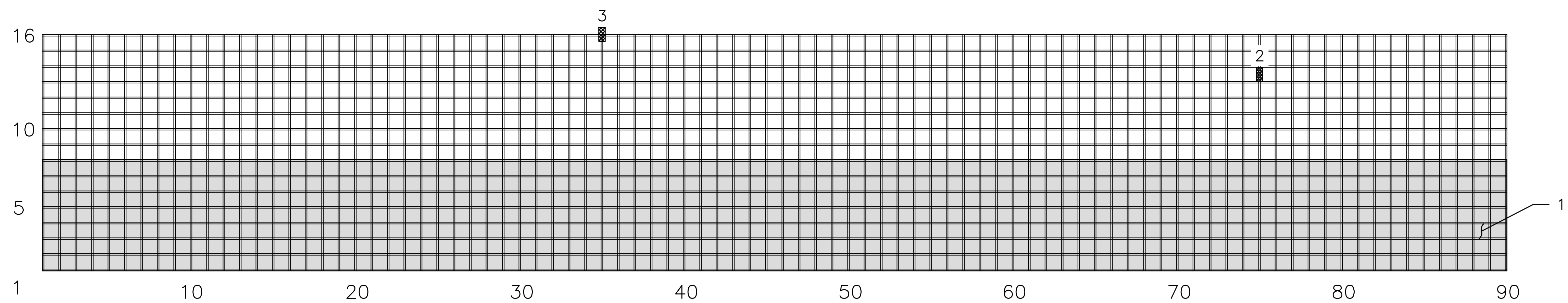
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	
tender soumission / project manager administrateur de projets	08 OF 65 drawing no. / dessine no.

GSC–A3A 95–09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2–4.dwg

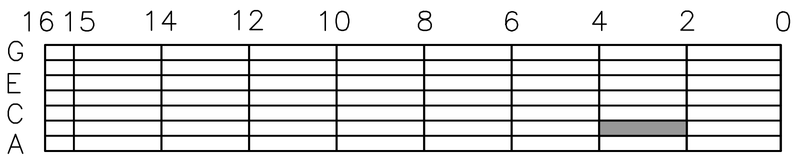
DATE PLOTTED: Monday, February 22, 2021 9:35:03 AM



2-4 - B

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN
drawn by dessine par

SW
designed by conc par

PH
approved by approuve par

tender soumission
project manager administrateur de projets

FEBRUARY 2021
project date date du projet

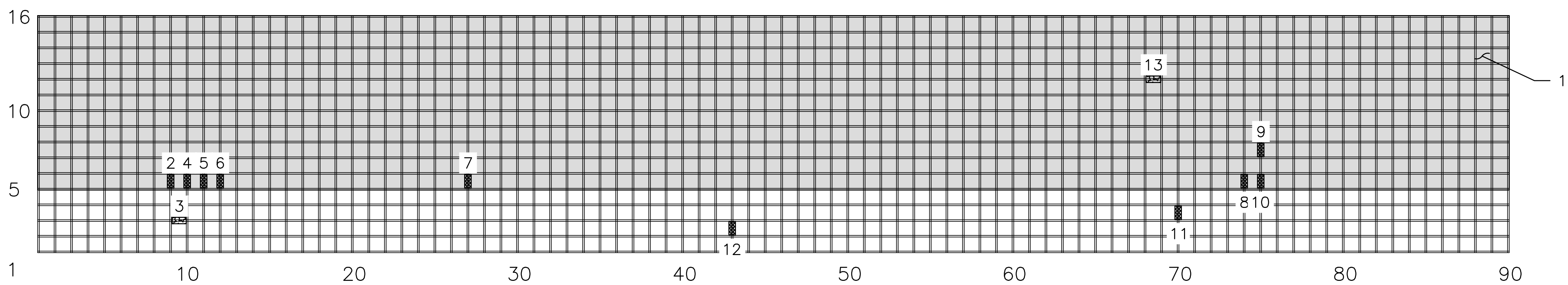
R.090045.001
project no. no. du projet

09 OF 65
drawing no. dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2-4.dwg

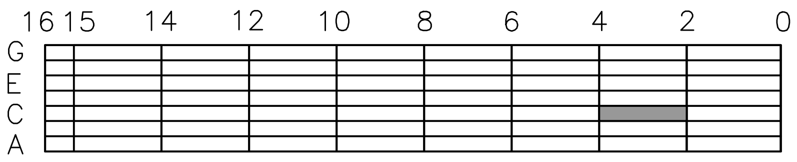
DATE PLOTTED: Monday, February 22, 2021 9:35:08 AM



2-4 – C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	CRACKED WELD
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR
11	BENT TRANSVERSE BAR
12	BENT TRANSVERSE BAR
13	CRACKED WELD ON SILL



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par

SW — designed by / conc par

PH — approved by / approuve par

tender / soumission — project manager / administrateur de projets

FEBRUARY 2021 — project date / date du projet

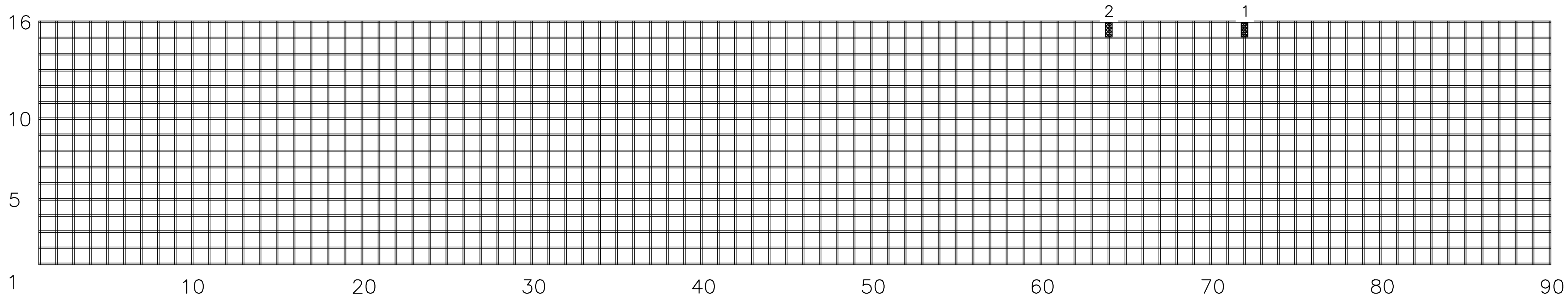
R.090045.001 — project no. / no. du projet

10 OF 65 — drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2-4.dwg

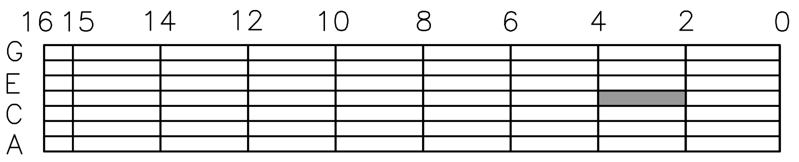
DATE PLOTTED: Monday, February 22, 2021 9:35:12 AM



2-4 – D

1:20

DEFECT No.	DESCRIPTION
1	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN
drawn by / dessine par

SW
designed by / conc par

PH
approved by / approuve par

tender / soumission — project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

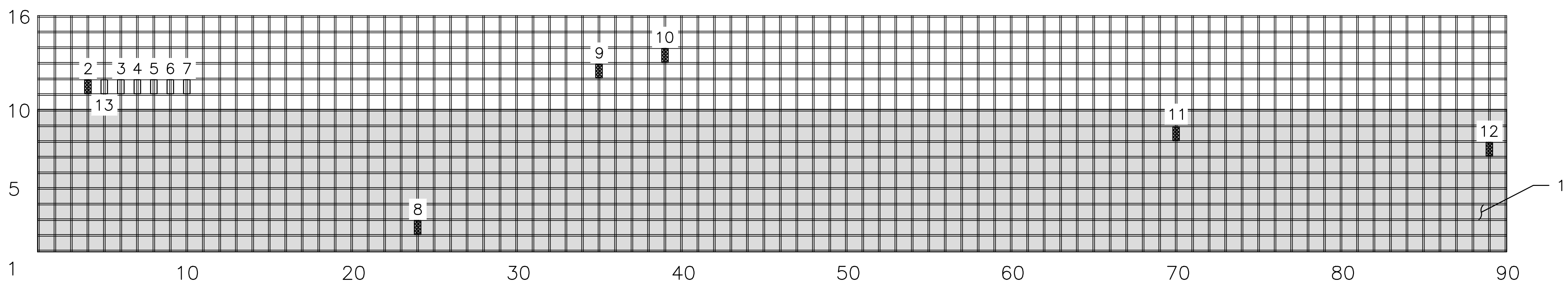
R.090045.001
project no. / no. du projet

11 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2-4.dwg

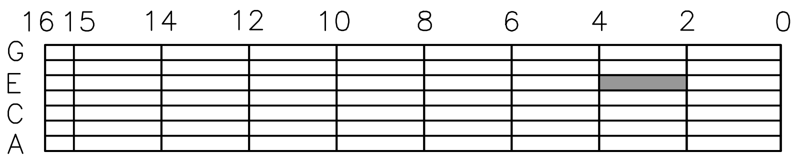
DATE PLOTTED: Monday, February 22, 2021 9:35:17 AM



2-4 - E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	STEEL BAR REPAIR
4	STEEL BAR REPAIR
5	STEEL BAR REPAIR
6	STEEL BAR REPAIR
7	STEEL BAR REPAIR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR
11	BENT TRANSVERSE BAR
12	BENT TRANSVERSE BAR
13	STEEL BAR REPAIR



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

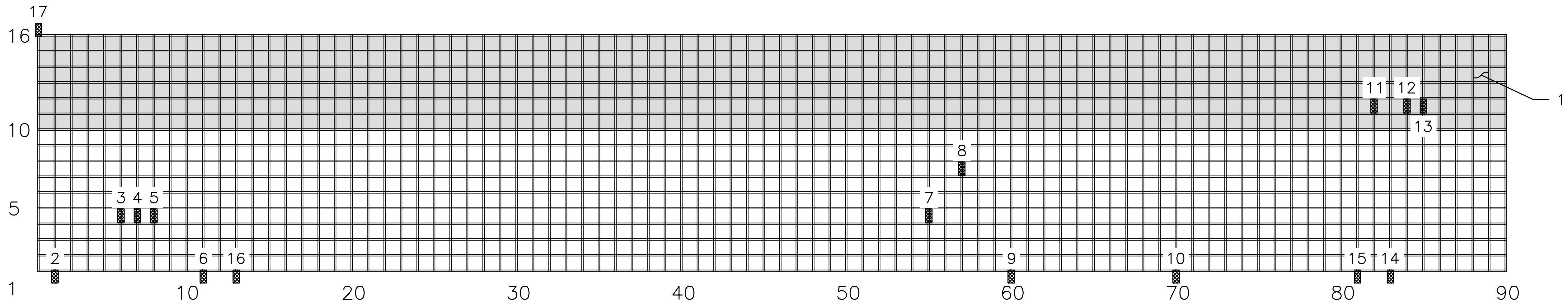
BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	12 OF 65 drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2-4.dwg

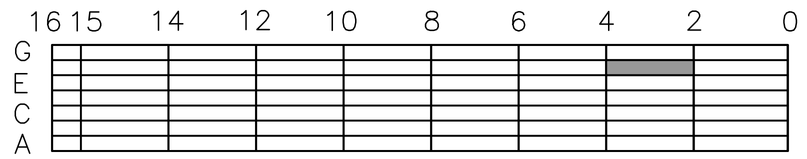
DATE PLOTTED: Monday, February 22, 2021 9:35:21 AM



2-4 - F

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	16	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR	17	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR		
4	BENT TRANSVERSE BAR		
5	BENT TRANSVERSE BAR		
6	BENT TRANSVERSE BAR		
7	BENT TRANSVERSE BAR		
8	BENT TRANSVERSE BAR		
9	BENT TRANSVERSE BAR		
10	BENT TRANSVERSE BAR		
11	BENT TRANSVERSE BAR		
12	BENT TRANSVERSE BAR		
13	BENT TRANSVERSE BAR		
14	BENT TRANSVERSE BAR		
15	BENT TRANSVERSE BAR		



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN
drawn by dessine par

SW
designed by conc par

PH
approved by approuve par

tender soumission
project manager administrateur de projets

FEBRUARY 2021
project date date du projet

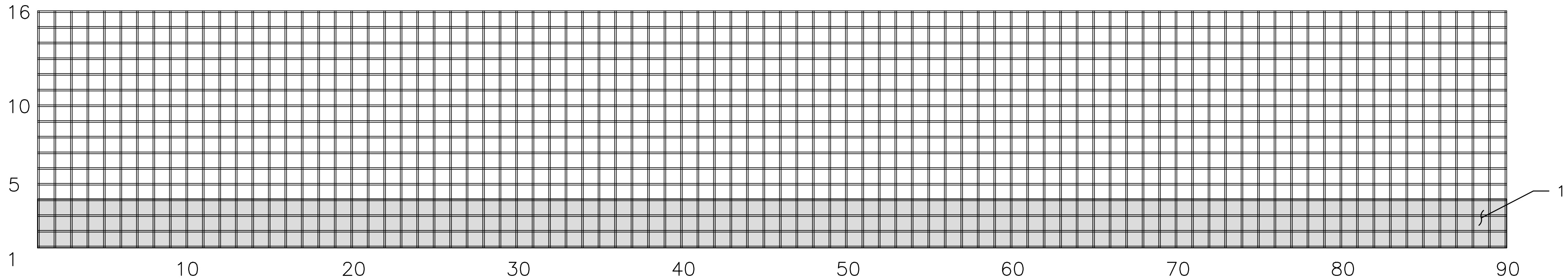
R.090045.001
project no. no. du projet

13 OF 65
drawing no. dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2-4.dwg

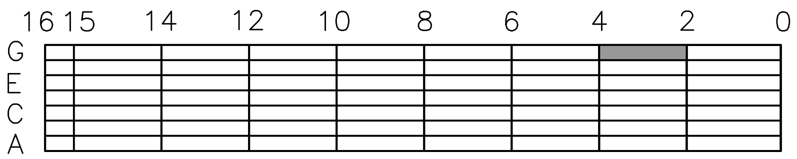
DATE PLOTTED: Monday, February 22, 2021 9:35:25 AM



2-4 - G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

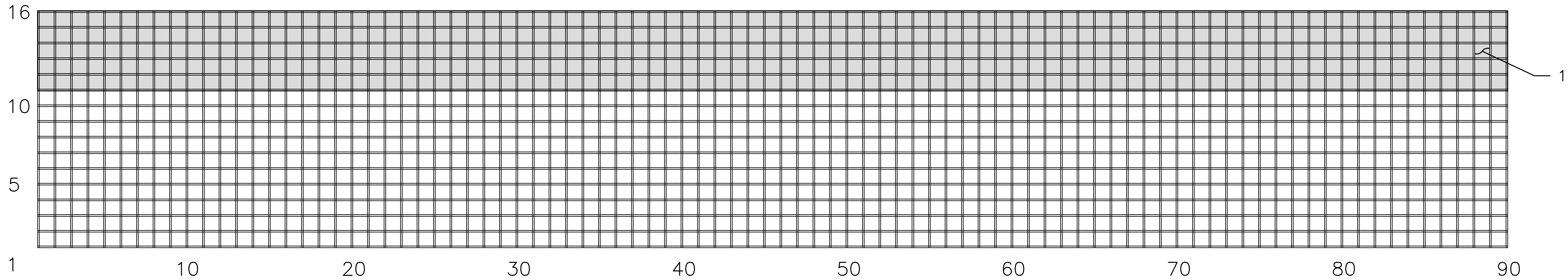
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	14 OF 65 — drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 2-4.dwg

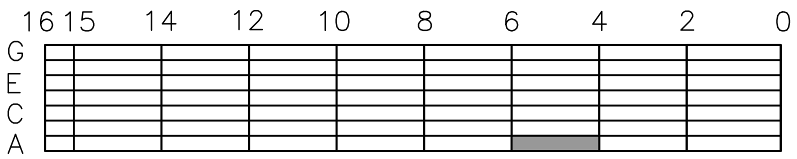
DATE PLOTTED: Monday, February 22, 2021 9:35:32 AM



4-6 - A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN
drawn by / dessine par

SW
designed by / conc par

PH
approved by / approuve par

tender / soumission
project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

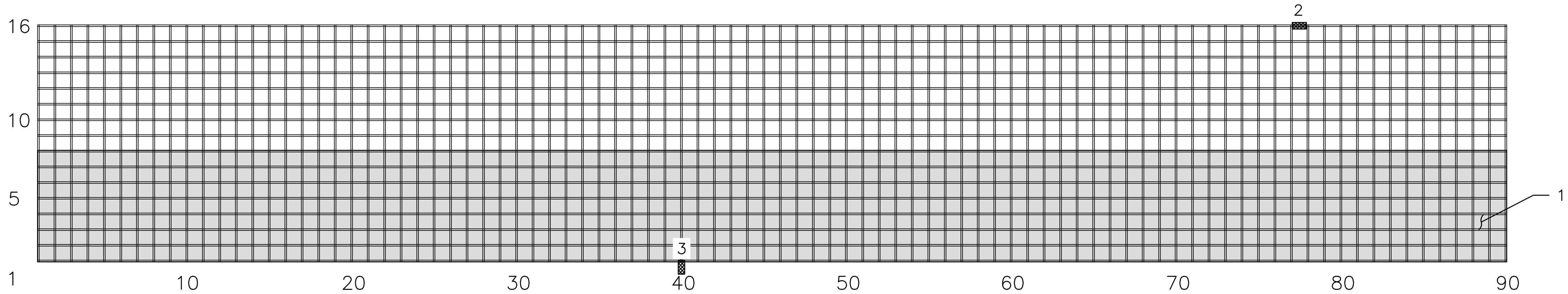
R.090045.001
project no. / no. du projet

15 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 4-6.dwg

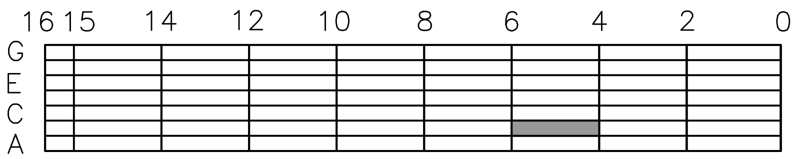
DATE PLOTTED: Monday, February 22, 2021 9:36:29 AM



4–6 – B

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	EXTERIOR BAR BENT



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets

FEBRUARY 2021
project date / date du projet

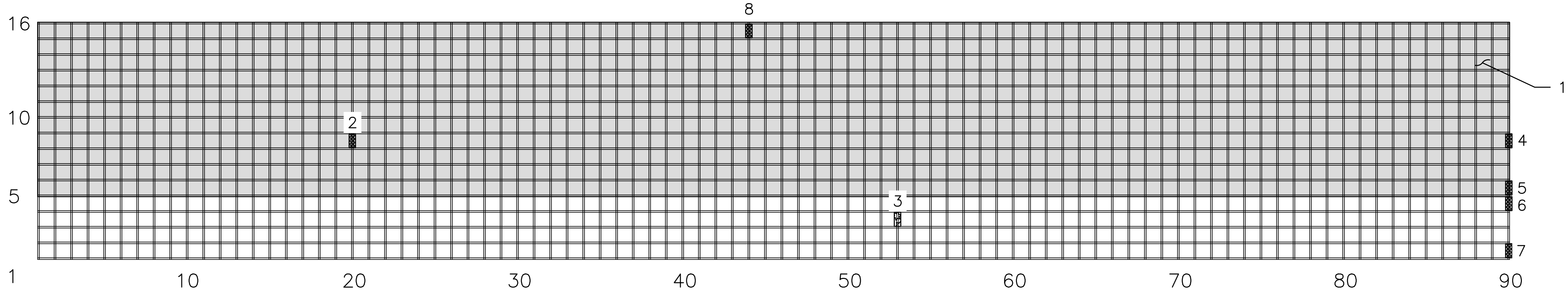
R.090045.001
project no. / no. du projet

16 OF 65
drawing no. / dessine no.

GSC–A3A 95–09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 4–6.dwg

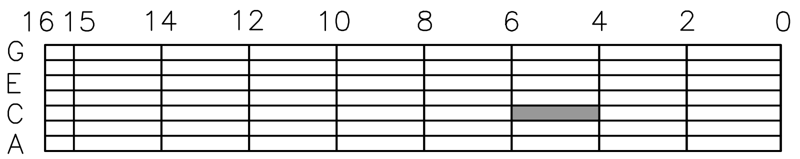
DATE PLOTTED: Monday, February 22, 2021 9:36:35 AM



4–6 – C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BROKEN TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

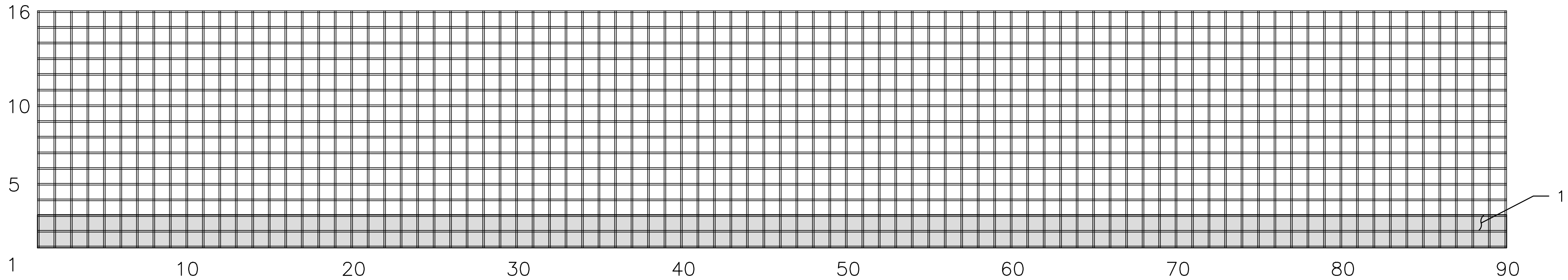
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	17 OF 65 drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 4-6.dwg

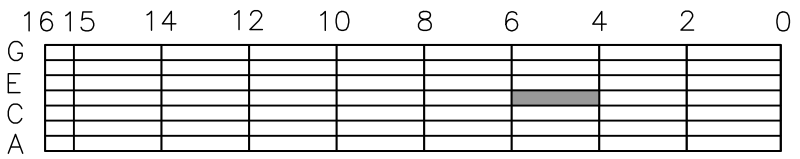
DATE PLOTTED: Monday, February 22, 2021 9:36:42 AM



4–6 – D

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region
Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO
DECK GRATING REPAIRS

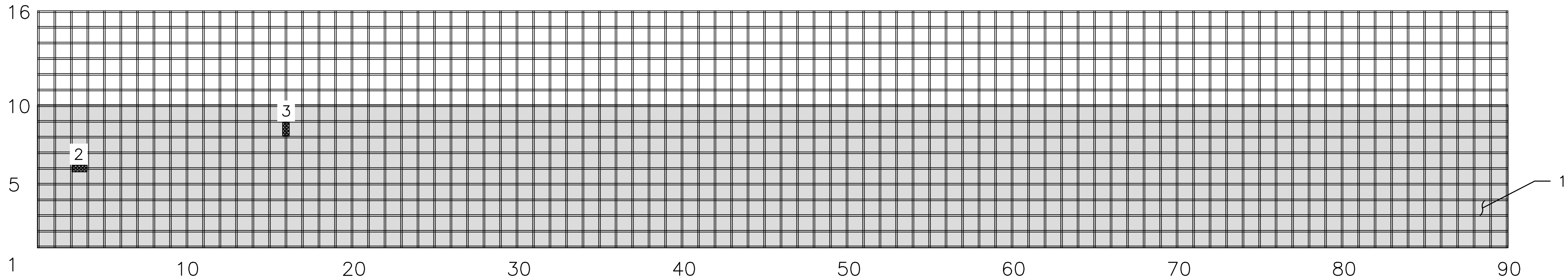
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	18 OF 65 drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 4-6.dwg

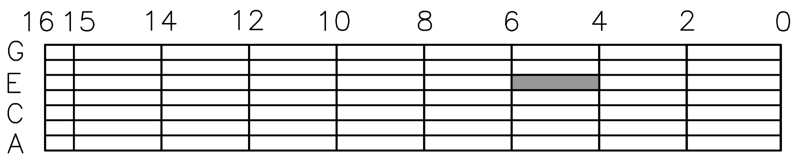
DATE PLOTTED: Monday, February 22, 2021 9:36:49 AM



4-6 - E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT LONGITUDINAL BAR
3	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

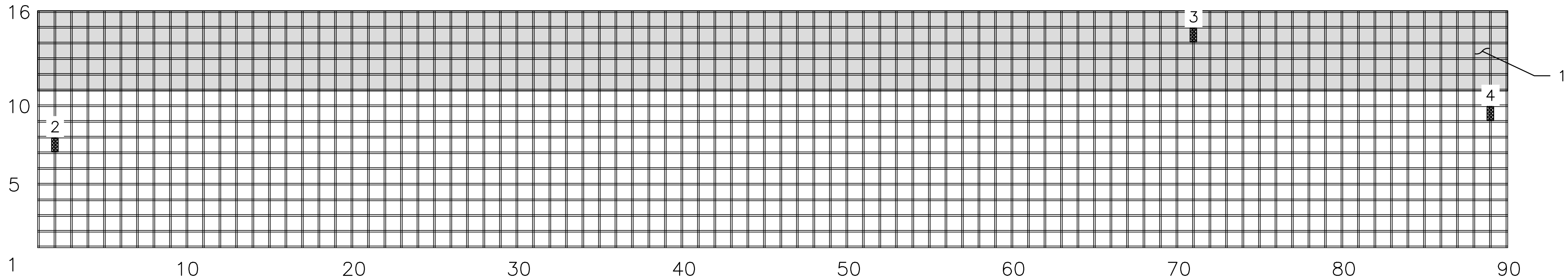
Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO
DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	19 OF 65 — drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

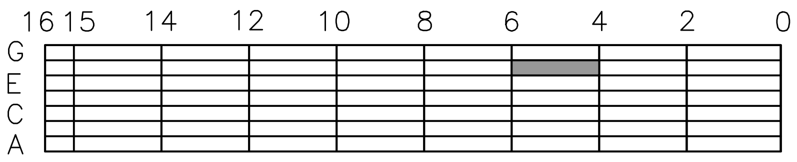
GSC-A3A 95-09



4-6 - F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

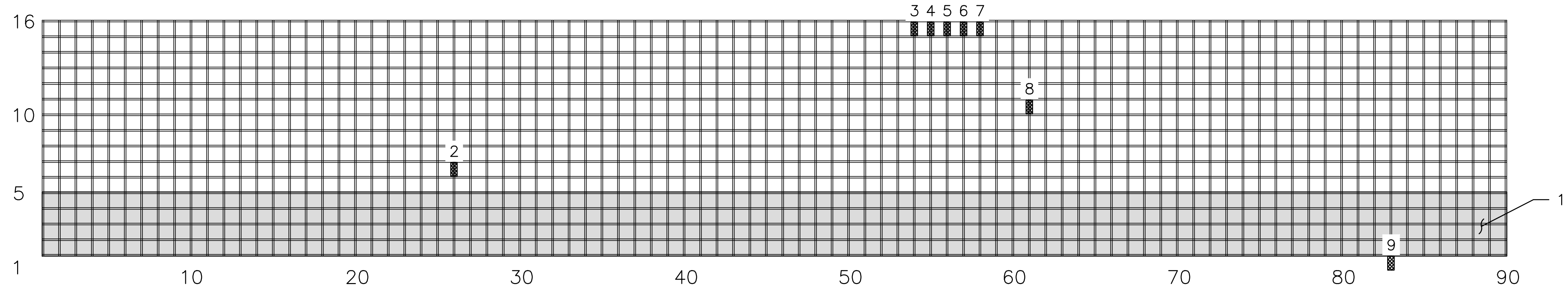
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	20 OF 65 drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 4-6.dwg

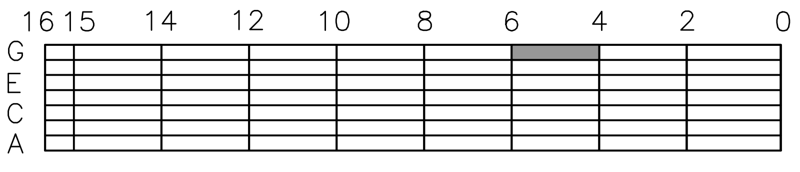
DATE PLOTTED: Monday, February 22, 2021 9:37:05 AM



4–6 – G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet

LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin

BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par

SW — designed by / conc par

PH — approved by / approuve par

tender / soumission — project manager / administrateur de projets

FEBRUARY 2021 — project date / date du projet

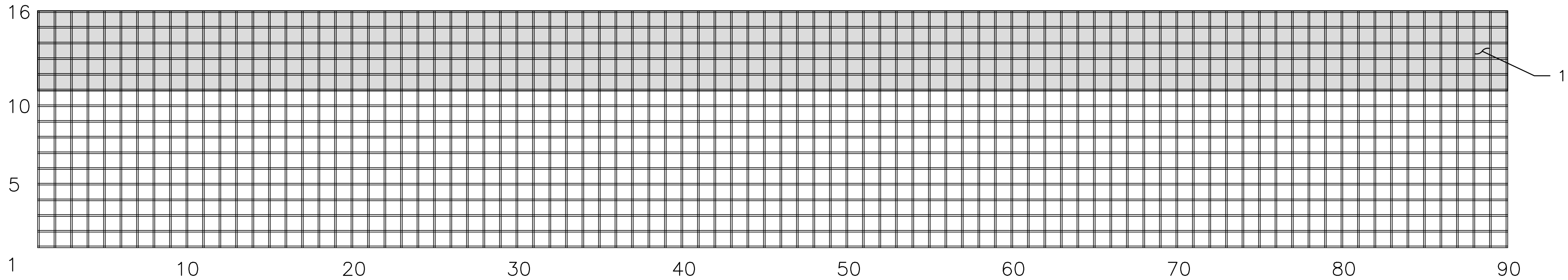
R.090045.001 — project no. / no. du projet

21 OF 65 — drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 4–6.dwg

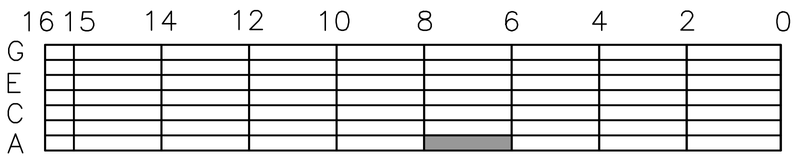
DATE PLOTTED: Monday, February 22, 2021 9:37:13 AM



6-8 – A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

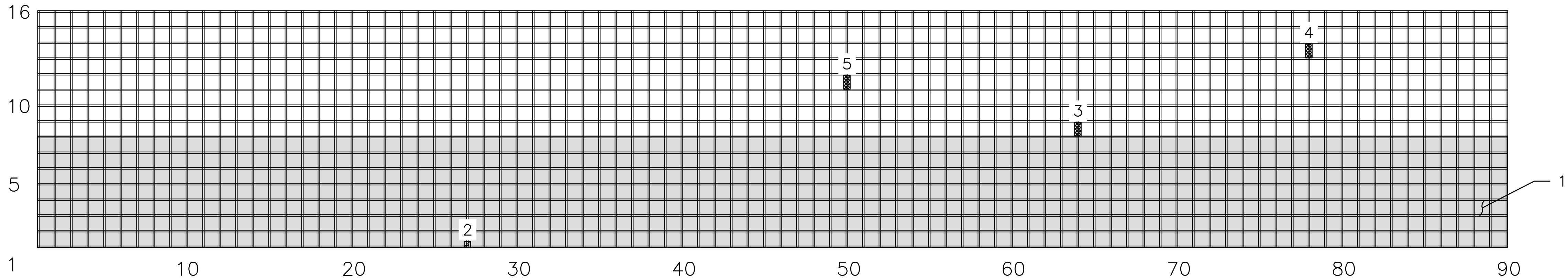
drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	
tender soumission / project manager administrateur de projets	22 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6-8.dwg

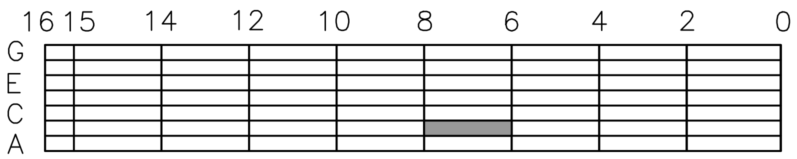
DATE PLOTTED: Monday, February 22, 2021 9:38:05 AM



6–8 – B

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BROKEN WELD
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region
Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO
DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING
DETERIORATIONS

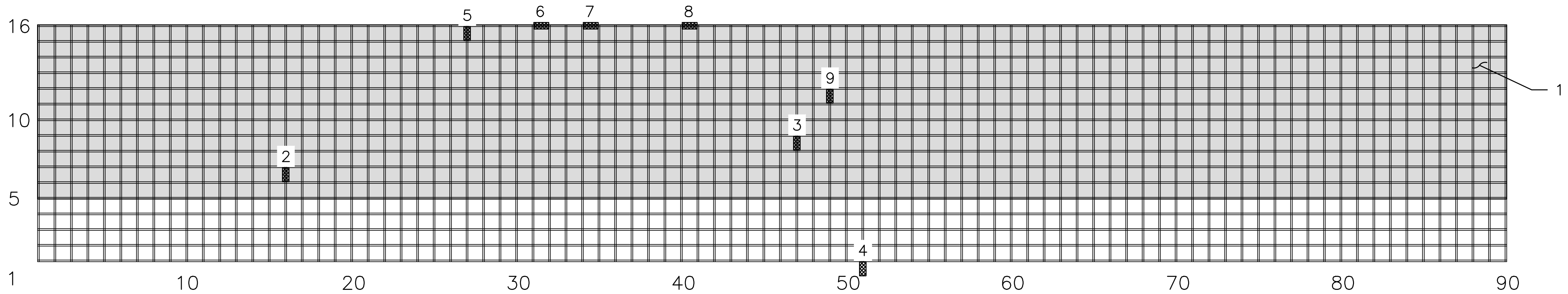
TN — drawn by / dessine par
SW — designed by / conc par
PH — approved by / approuve par
tender / soumission — project manager / administrateur de projets

FEBRUARY 2021 — project date / date du projet
R.090045.001 — project no. / no. du projet
23 OF 65 — drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6–8.dwg

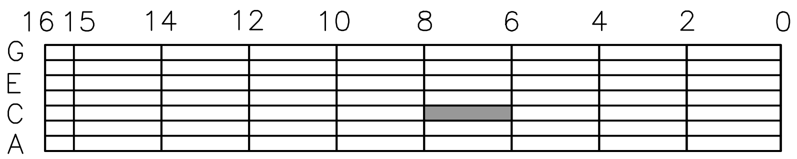
DATE PLOTTED: Monday, February 22, 2021 9:38:10 AM



6-8 - C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR WITH BROKEN WELD
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT LONGITUDINAL BAR
7	BENT LONGITUDINAL BAR
8	BENT LONGITUDINAL BAR
9	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

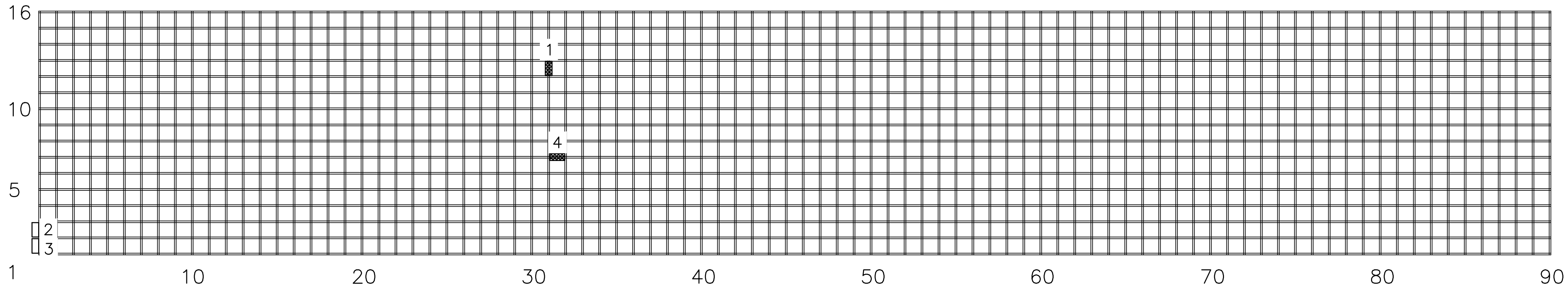
BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	24 OF 65 drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6-8.dwg

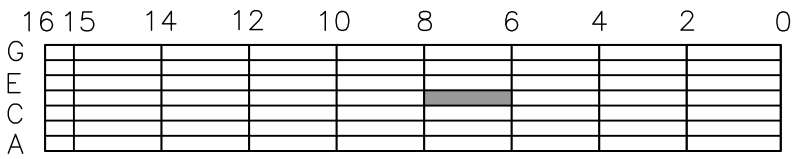
DATE PLOTTED: Monday, February 22, 2021 9:38:13 AM



6-8 – D

1:20

DEFECT No.	DESCRIPTION
1	BENT TRANSVERSE BAR
2	PROGRESSIVE WEAR
3	WORN SERATIONS
4	BENT LONGITUDINAL BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

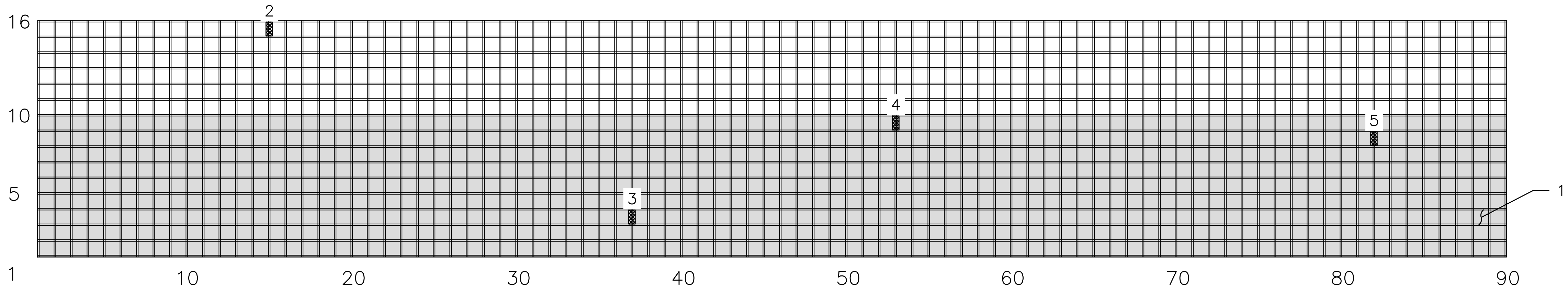
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	25 OF 65 — drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6-8.dwg

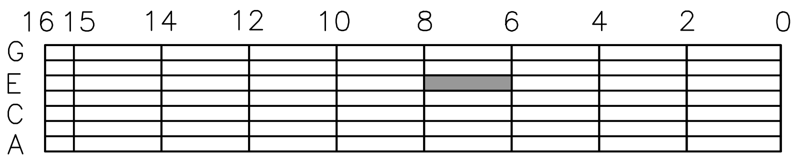
DATE PLOTTED: Monday, February 22, 2021 9:38:18 AM



6-8 – E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par
SW designed by / conc par
PH approved by / approuve par
tender soumission / project manager administrateur de projets

FEBRUARY 2021
project date / date du projet

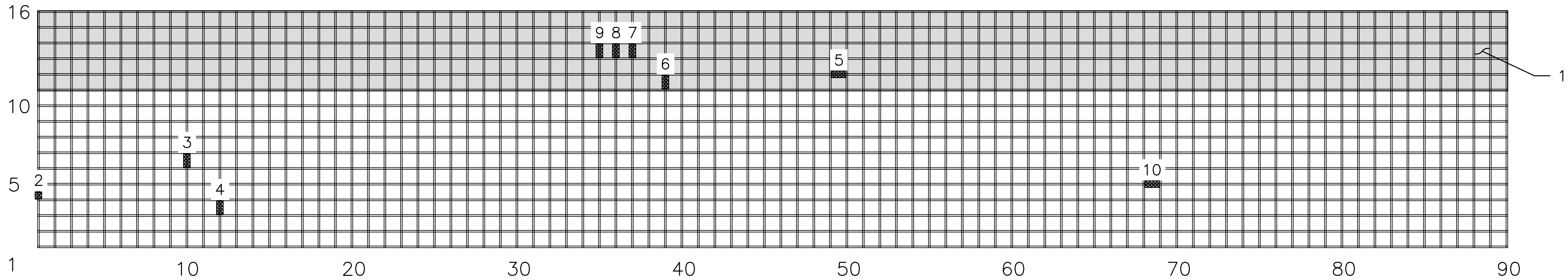
R.090045.001
project no. / no. du projet

26 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6-8.dwg

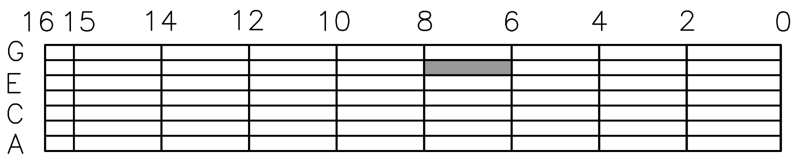
DATE PLOTTED: Monday, February 22, 2021 9:38:22 AM



6-8 - F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	CRACKED WELD
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT LONGITUDINAL BAR
6	BENT LONGITUDINAL BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	CRACKED WELD TO SILL



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

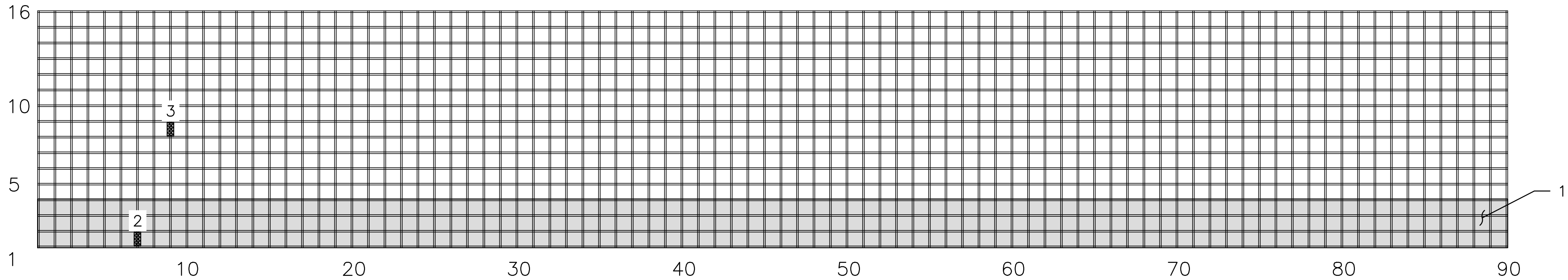
TN drawn by / dessine par
SW designed by / conc par
PH approved by / approuve par
tender / soumission — project manager / administrateur de projets

FEBRUARY 2021 project date / date du projet
R.090045.001 project no. / no. du projet
27 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6-8.dwg

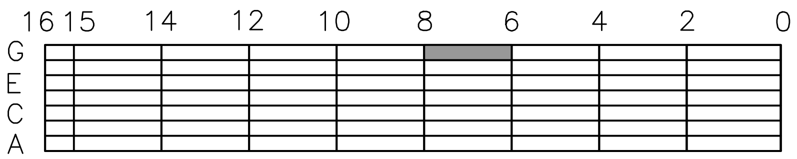
DATE PLOTTED: Monday, February 22, 2021 9:38:26 AM



6-8 – G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
tender / soumission	project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

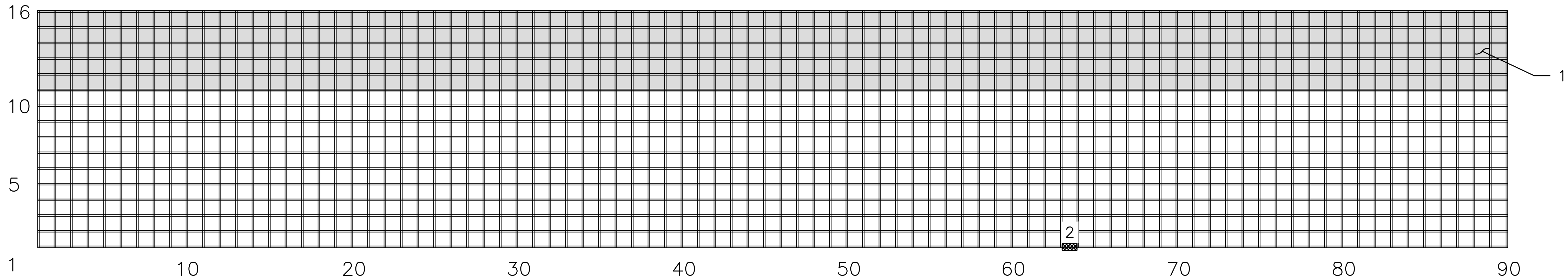
R.090045.001
project no. / no. du projet

28 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 6-8.dwg

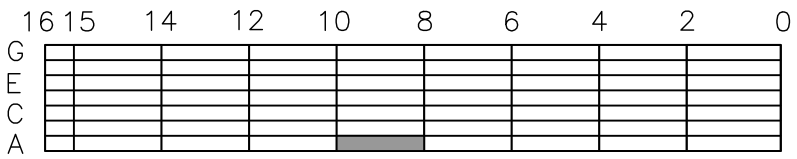
DATE PLOTTED: Monday, February 22, 2021 9:38:31 AM



8–10 – A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT LONGITUDINAL BAR



GSC-A3A 95-09

Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

BRIDGE GRATING
DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets

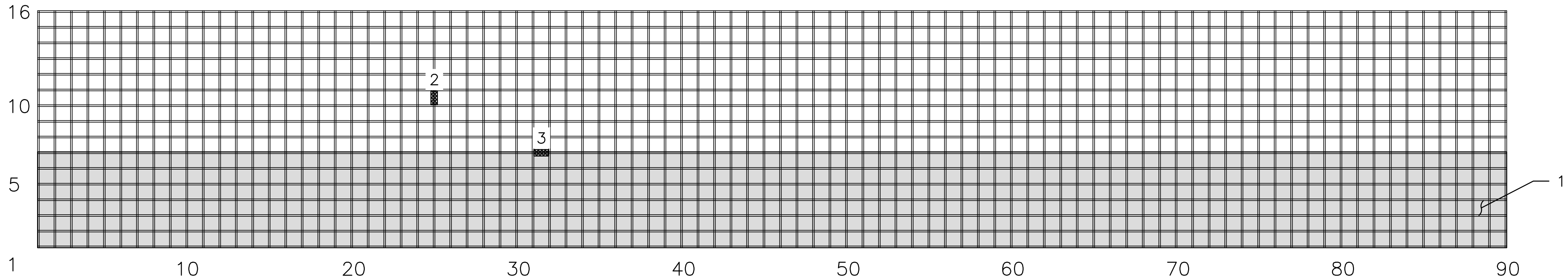
FEBRUARY 2021
project date / date du projet

R.090045.001
project no. / no. du projet

29 OF 65
drawing no. / dessine no.

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 8–10.dwg

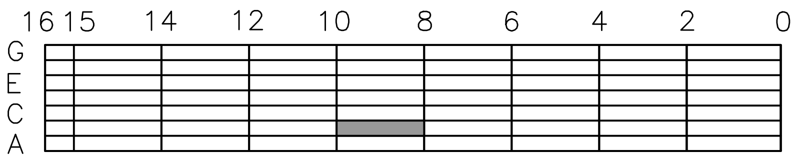
DATE PLOTTED: Monday, February 22, 2021 9:39:26 AM



8–10 – B

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT LONGITUDINAL BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

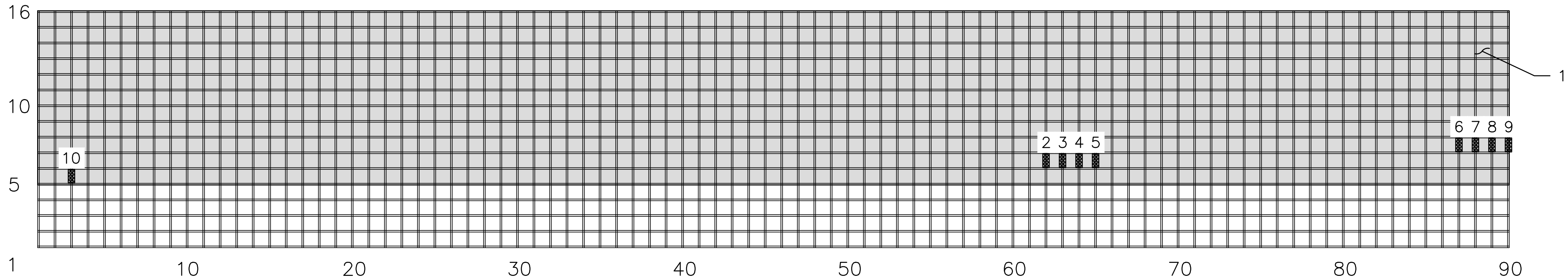
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	30 OF 65 — drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 8–10.dwg

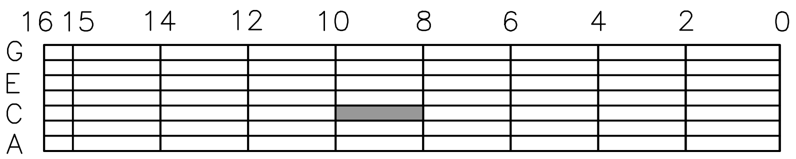
DATE PLOTTED: Monday, February 22, 2021 9:39:30 AM



8–10 – C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

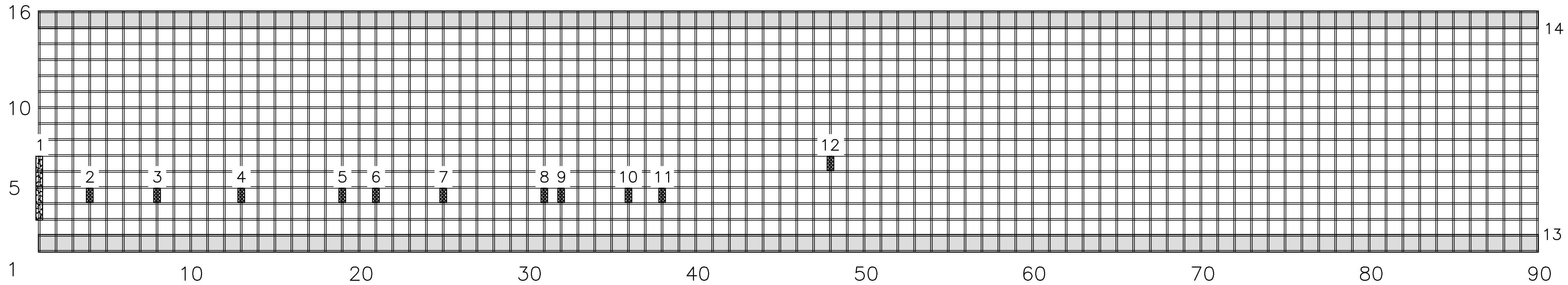
project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	
tender / soumission — project manager / administrateur de projets	31 OF 65 — drawing no. / dessine no.

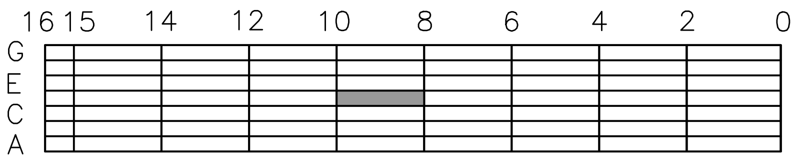
GSC-A3A 95-09



8–10 – D

1:20

DEFECT No.	DESCRIPTION
1	CRACKED WELD TO ADJOINING PANEL
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR
11	BENT TRANSVERSE BAR
12	BENT TRANSVERSE BAR
13	WORN SERRATIONS
14	WORN SERRATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN
drawn by / dessine par

SW
designed by / conc par

PH
approved by / approuve par

tender / soumission — project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

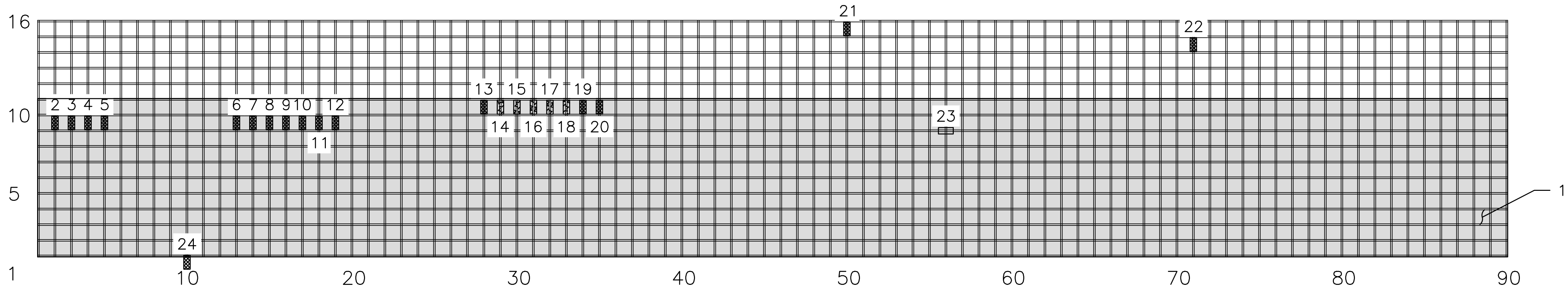
R.090045.001
project no. / no. du projet

32 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 8-10.dwg

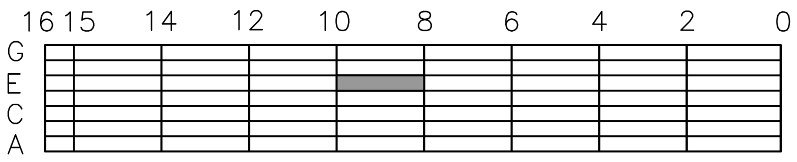
DATE PLOTTED: Monday, February 22, 2021 9:39:40 AM



8–10 – E

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	13	BENT TRANSVERSE BAR
2	BROKEN TRANSVERSE BAR	14	REPAIRED STEEL BAR
3	BROKEN TRANSVERSE BAR	15	REPAIRED STEEL BAR
4	BROKEN TRANSVERSE BAR	16	REPAIRED STEEL BAR
5	BENT TRANSVERSE BAR	17	REPAIRED STEEL BAR
6	BENT TRANSVERSE BAR	18	REPAIRED STEEL BAR
7	BENT TRANSVERSE BAR	19	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR	20	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR	21	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR	22	BROKEN TRANSVERSE BAR
11	BENT TRANSVERSE BAR	23	MISSING BOLT ON 1 SIDE OF SILL
12	BENT TRANSVERSE BAR	24	EXTERIOR BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN
drawn by / dessine par

SW
designed by / conc par

PH
approved by / approuve par

tender soumission / project manager administrateur de projets

FEBRUARY 2021
project date / date du projet

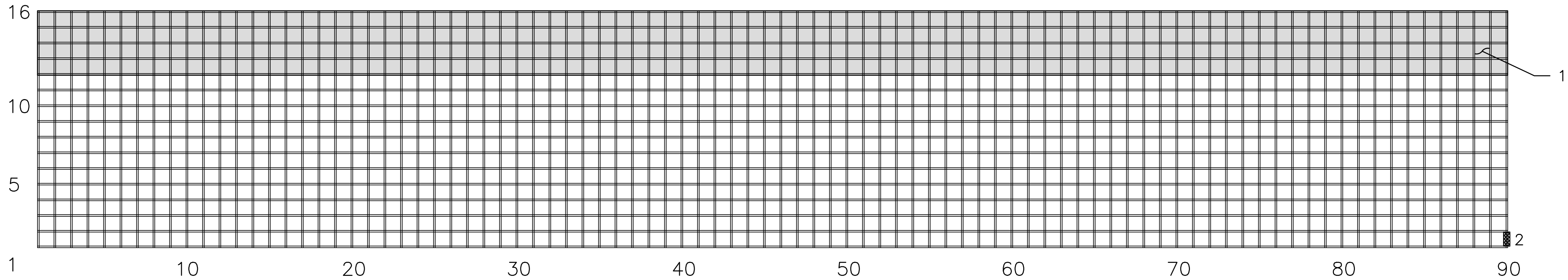
R.090045.001
project no. / no. du projet

33 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 8-10.dwg

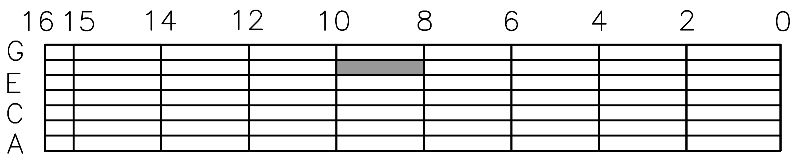
DATE PLOTTED: Monday, February 22, 2021 9:39:44 AM



8–10 – F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN
drawn by dessine par

SW
designed by conc par

PH
approved by approuve par

tender soumission project manager administrateur de projets

FEBRUARY 2021
project date date du projet

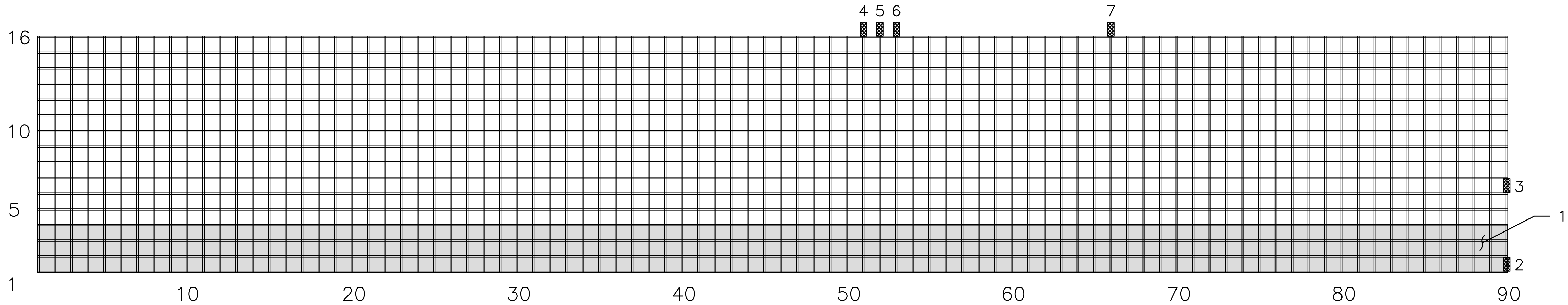
R.090045.001
project no. no. du projet

34 OF 65
drawing no. dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 8-10.dwg

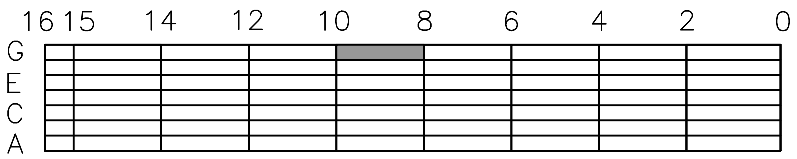
DATE PLOTTED: Monday, February 22, 2021 9:39:48 AM



8-10 - G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT EXT. TRANSVERSE BAR
5	BENT EXT. TRANSVERSE BAR
6	BENT EXT. TRANSVERSE BAR
7	BENT EXT. TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

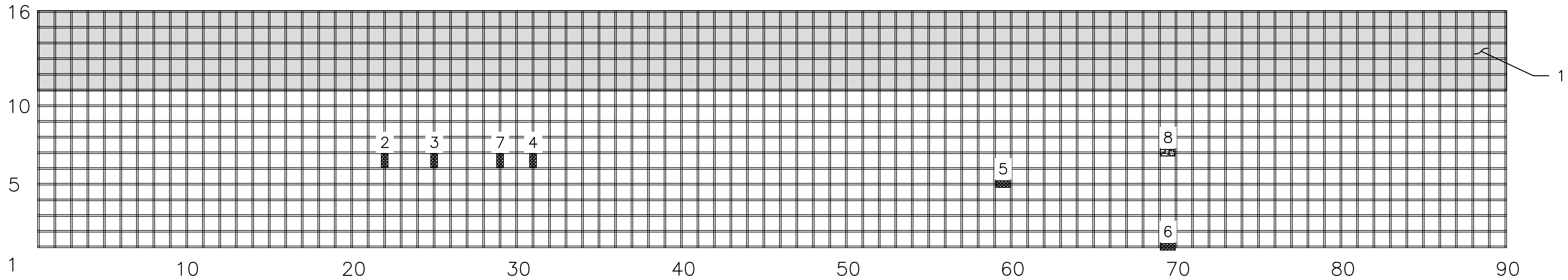
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	
tender / soumission — project manager / administrateur de projets	35 OF 65 — drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 8-10.dwg

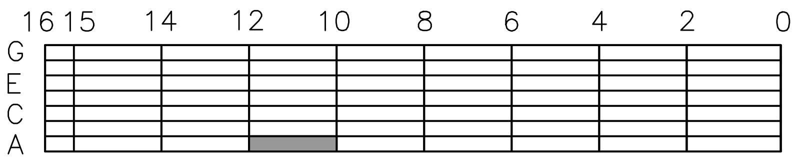
DATE PLOTTED: Monday, February 22, 2021 9:39:53 AM



10–12 – A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT LONGITUDINAL BAR
6	BENT LONGITUDINAL BAR
7	BENT TRANSVERSE BAR
8	CRACKED WELD



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets

FEBRUARY 2021
project date / date du projet

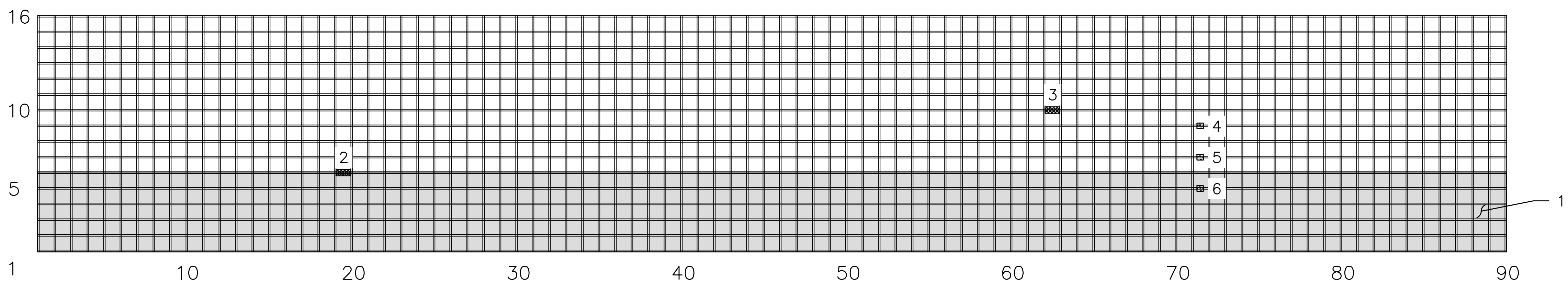
R.090045.001
project no. / no. du projet

36 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

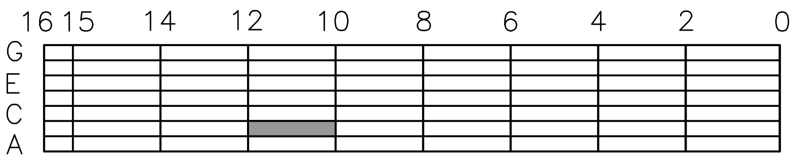
DATE PLOTTED: Monday, February 22, 2021 9:40:43 AM



10–12 – B

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT LONGITUDINAL BAR
3	BENT LONGITUDINAL BAR
4	BROKEN WELD
5	BROKEN WELD
6	BROKEN WELD



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

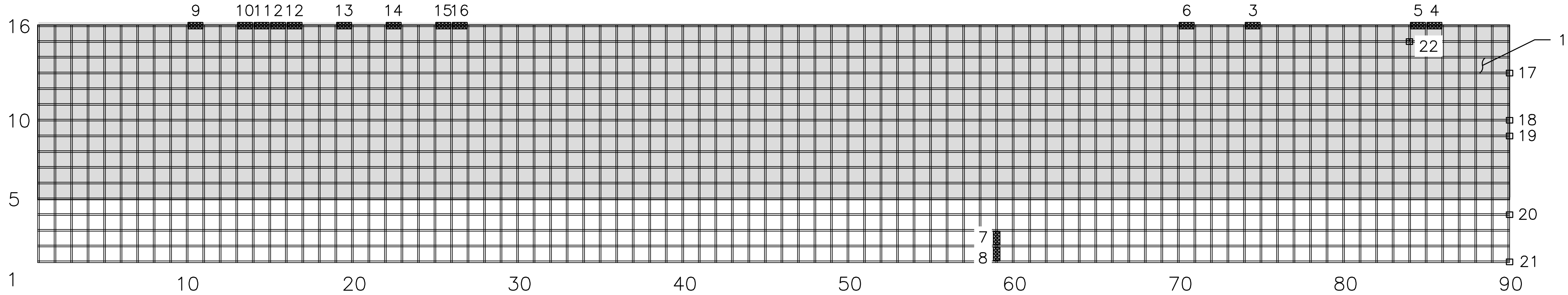
drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	
tender soumission / project manager administrateur de projets	37 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

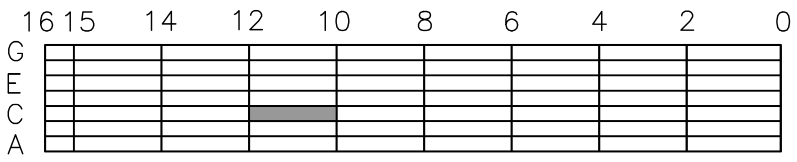
DATE PLOTTED: Monday, February 22, 2021 9:40:48 AM



10–12 – C

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	16	BENT LONGITUDINAL BAR
2	BENT LONGITUDINAL BAR	17	CRACK AT TACK WELD
3	BENT LONGITUDINAL BAR	18	CRACK AT TACK WELD
4	BENT LONGITUDINAL BAR	19	CRACK AT TACK WELD
5	BENT LONGITUDINAL BAR	20	CRACK AT TACK WELD
6	BENT LONGITUDINAL BAR	21	CRACK AT TACK WELD
7	BENT TRANSVERSE BAR	22	MISSING BOLT
8	BENT TRANSVERSE BAR		
9	BENT LONGITUDINAL BAR		
10	BENT LONGITUDINAL BAR		
11	BENT LONGITUDINAL BAR		
12	BENT LONGITUDINAL BAR		
13	BENT LONGITUDINAL BAR		
14	BENT LONGITUDINAL BAR		
15	BENT LONGITUDINAL BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

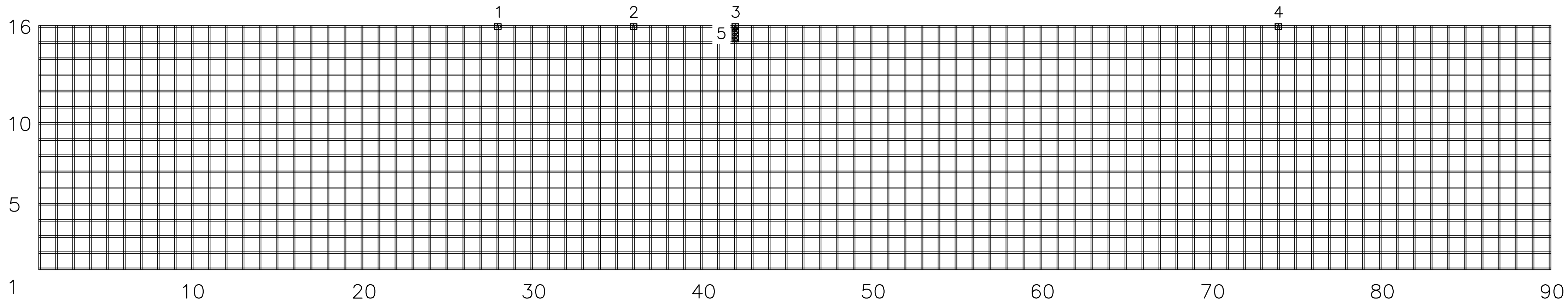
BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	38 OF 65 drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

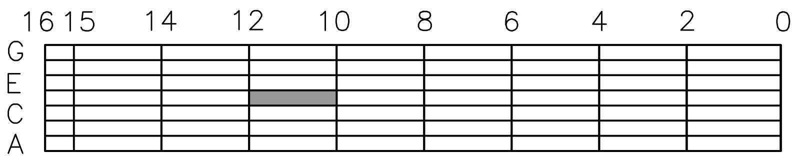
DATE PLOTTED: Monday, February 22, 2021 9:40:52 AM



10–12 – D

1:20

DEFECT No.	DESCRIPTION
1	CRACKED WELD
2	CRACKED WELD
3	CRACKED WELD
4	CRACKED WELD
5	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

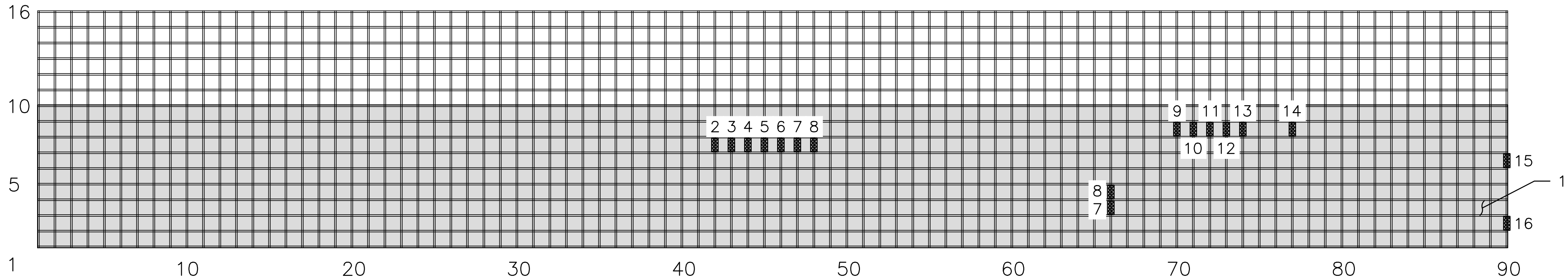
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

drawn by / dessine par	TN
designed by / conc par	SW
approved by / approuve par	PH
tender / soumission	project manager / administrateur de projets
project date / date du projet	FEBRUARY 2021
project no. / no. du projet	R.090045.001
drawing no. / dessine no.	39 OF 65

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

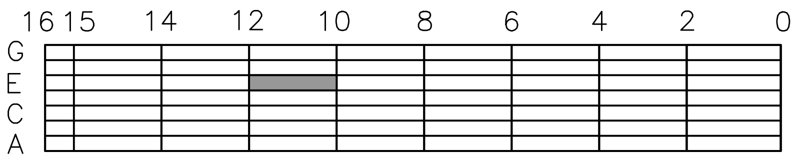
DATE PLOTTED: Monday, February 22, 2021 9:40:58 AM



10–12 – E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR
11	BENT TRANSVERSE BAR
12	BENT TRANSVERSE BAR
13	BENT TRANSVERSE BAR
14	BENT TRANSVERSE BAR
15	BENT TRANSVERSE BAR
16	BENT TRANSVERSE BAR
17	BENT TRANSVERSE BAR
18	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
tender / soumission	project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

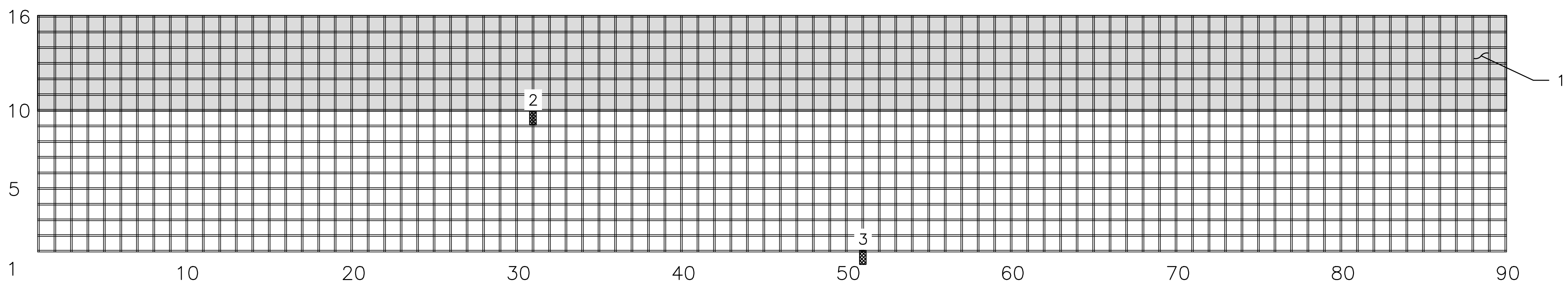
R.090045.001
project no. / no. du projet

40 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

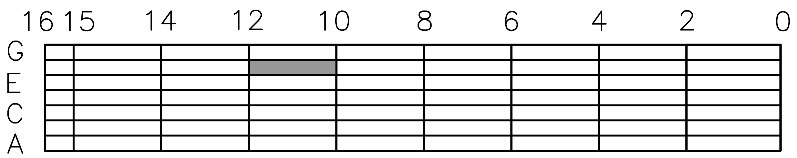
DATE PLOTTED: Monday, February 22, 2021 9:41:02 AM



10–12 – F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	2 MISSING SILL BOLTS ON ONE SIDE
3	EXTERIOR BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO
DECK GRATING REPAIRS

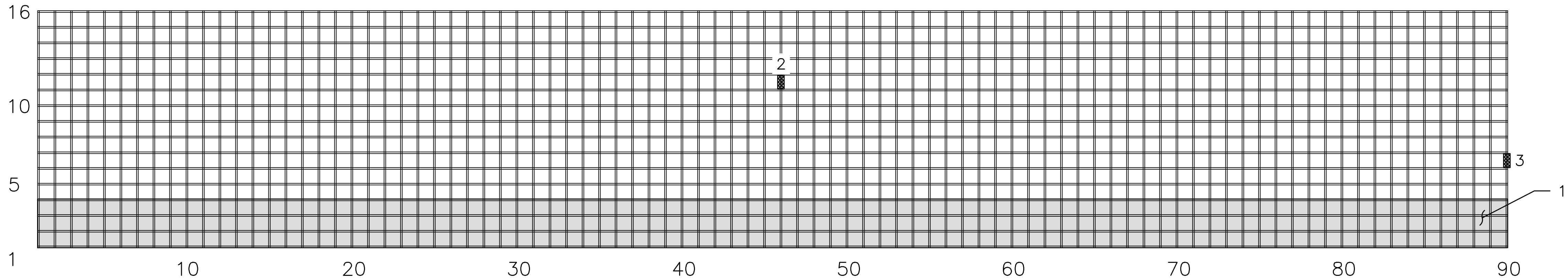
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	41 OF 65 — drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

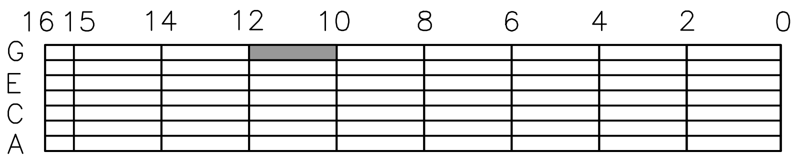
DATE PLOTTED: Monday, February 22, 2021 9:41:06 AM



10-12 - G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
tender / soumission	project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

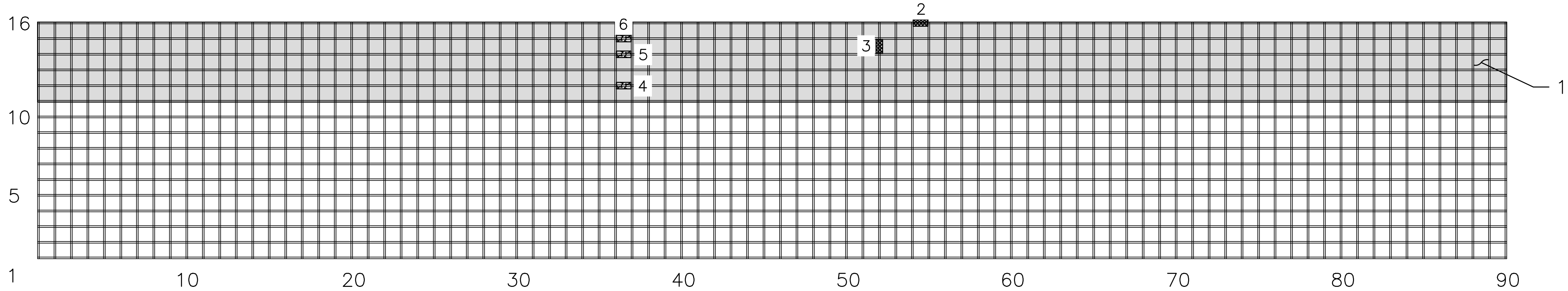
R.090045.001
project no. / no. du projet

42 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 10-12.dwg

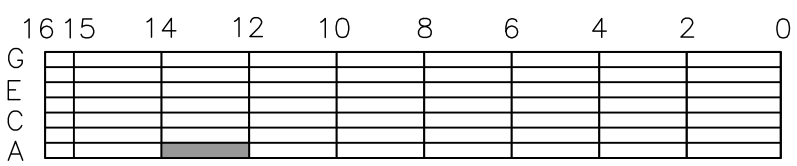
DATE PLOTTED: Monday, February 22, 2021 9:41:10 AM



12–14 – A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT LONGITUDINAL BAR
3	BENT LONGITUDINAL BAR
4	CRACKED WELD TO SILL
5	CRACKED WELD TO SILL
6	CRACKED WELD TO SILL



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

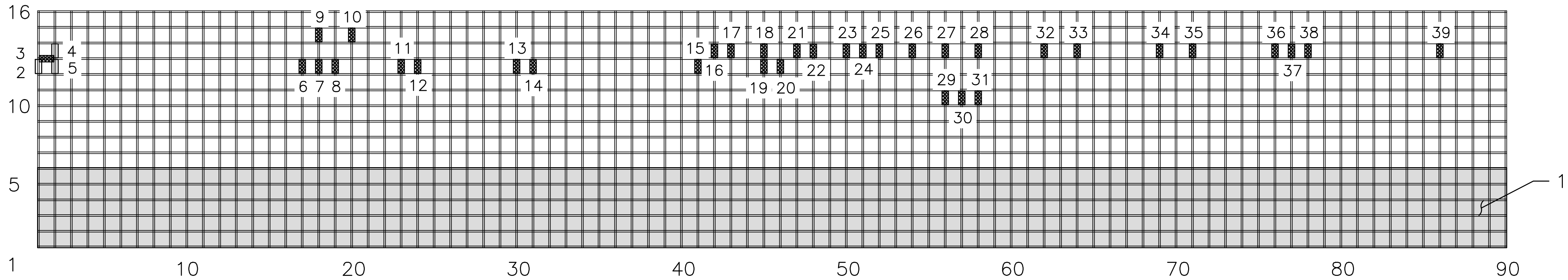
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets
FEBRUARY 2021	project date / date du projet
R.090045.001	project no. / no. du projet
43 OF 65	drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12–14.dwg

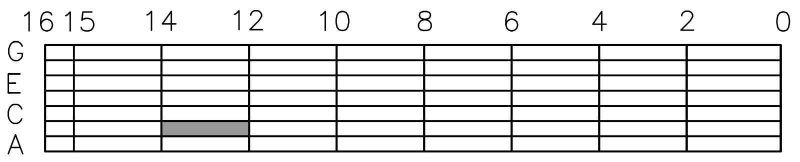
DATE PLOTTED: Monday, February 22, 2021 9:42:08 AM



12–14 – B

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	21	BENT TRANSVERSE BAR
2	REPAIRED STEEL BAR	22	BENT TRANSVERSE BAR
3	BENT LONGITUDINAL BAR	23	BENT TRANSVERSE BAR
4	REPAIRED STEEL BAR	24	BENT TRANSVERSE BAR
5	REPAIRED STEEL BAR	25	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR	26	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR	27	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR	28	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR	29	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR	30	BENT TRANSVERSE BAR
11	BENT TRANSVERSE BAR	31	BENT TRANSVERSE BAR
12	BENT TRANSVERSE BAR	32	BENT TRANSVERSE BAR
13	BENT TRANSVERSE BAR	33	BENT TRANSVERSE BAR
14	BENT TRANSVERSE BAR	34	BENT TRANSVERSE BAR
15	BENT TRANSVERSE BAR	35	BENT TRANSVERSE BAR
16	BENT TRANSVERSE BAR	36	BENT TRANSVERSE BAR
17	BENT TRANSVERSE BAR	37	BENT TRANSVERSE BAR
18	BENT TRANSVERSE BAR	38	BENT TRANSVERSE BAR
19	BENT TRANSVERSE BAR	39	BENT TRANSVERSE BAR
20	BENT TRANSVERSE BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
tender / soumission	project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

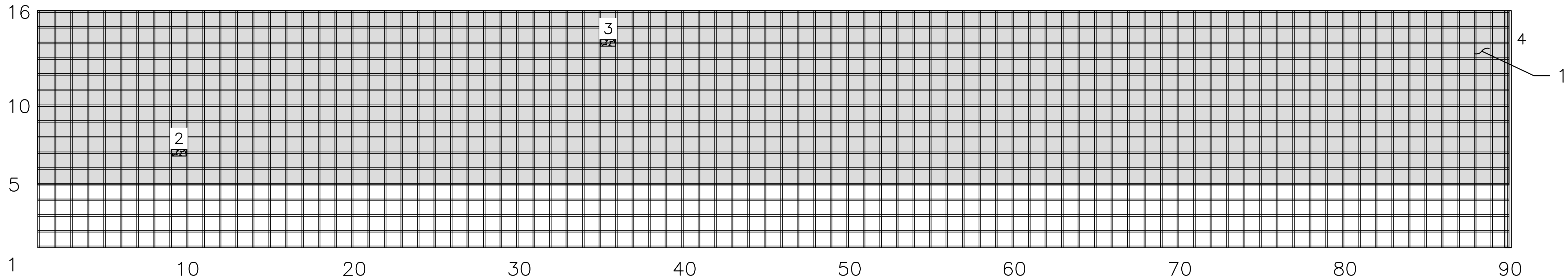
R.090045.001
project no. / no. du projet

44 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12-14.dwg

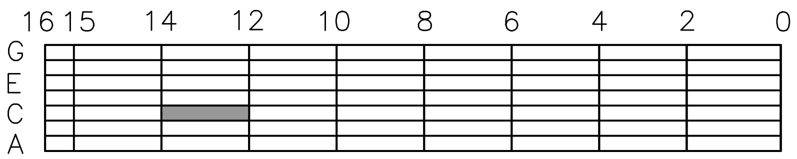
DATE PLOTTED: Monday, February 22, 2021 9:42:12 AM



12-14 - C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	CRACKED WELD TO SILL
3	CRACKED WELD TO SILL
4	CRACKED TACK WELDS TO ADJACENT PANEL



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

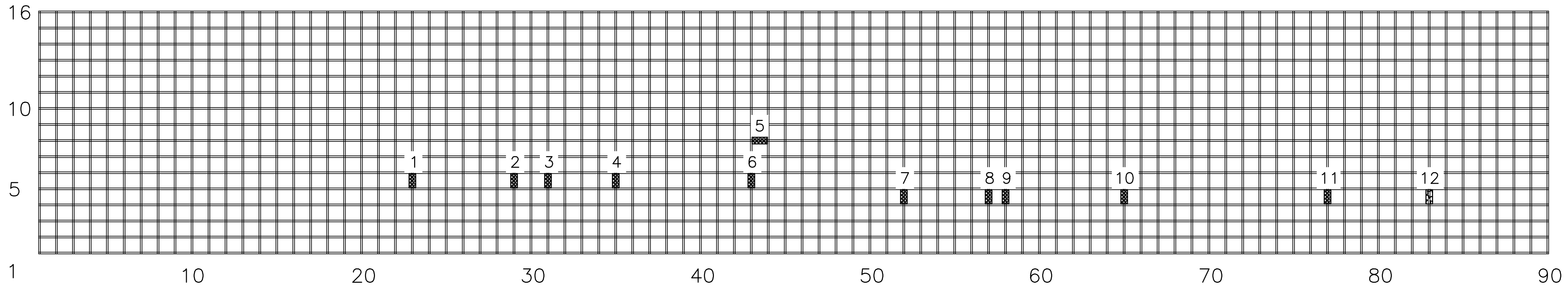
TN — drawn by / dessine par
SW — designed by / conc par
PH — approved by / approuve par
tender / soumission — project manager / administrateur de projets

FEBRUARY 2021 — project date / date du projet
R.090045.001 — project no. / no. du projet
45 OF 65 — drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12-14.dwg

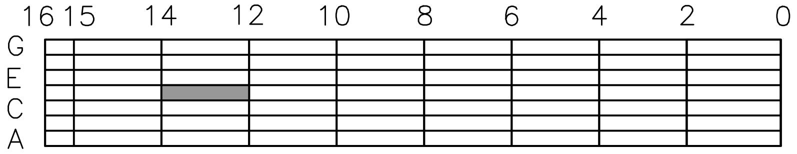
DATE PLOTTED: Monday, February 22, 2021 9:42:17 AM



12–14 – D

1:20

DEFECT No.	DESCRIPTION
1	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT LONGITUDINAL BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR
11	BENT TRANSVERSE BAR
12	BROKEN TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

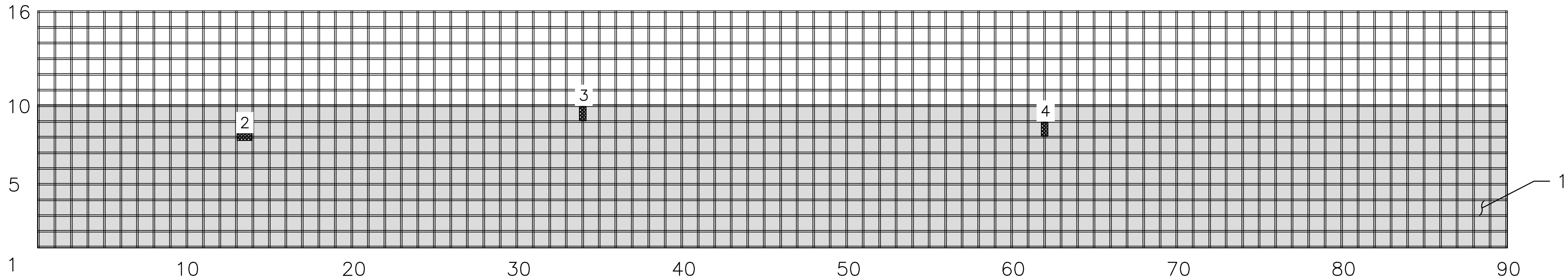
drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	
tender soumission / project manager administrateur de projets	46 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12-14.dwg

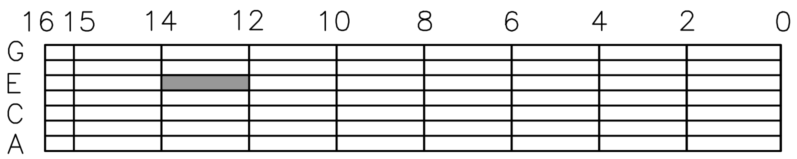
DATE PLOTTED: Monday, February 22, 2021 9:42:21 AM



12-14 - E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT LONGITUDINAL BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR



GSC-A3A 95-09

Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

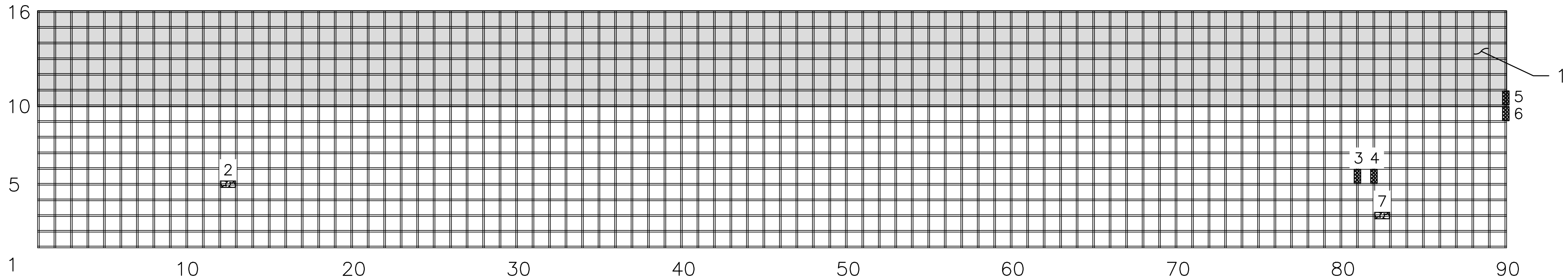
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par
SW — designed by / conc par
PH — approved by / approuve par
tender / soumission — project manager / administrateur de projets

FEBRUARY 2021 — project date / date du projet
R.090045.001 — project no. / no. du projet
47 OF 65 — drawing no. / dessine no.

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12-14.dwg

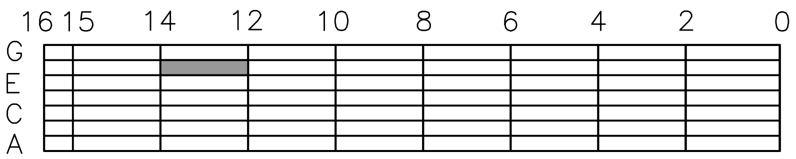
DATE PLOTTED: Monday, February 22, 2021 9:42:25 AM



12–14 – F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	CRACKED WELD TO SILL
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	CRACKED WELD TO SILL



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

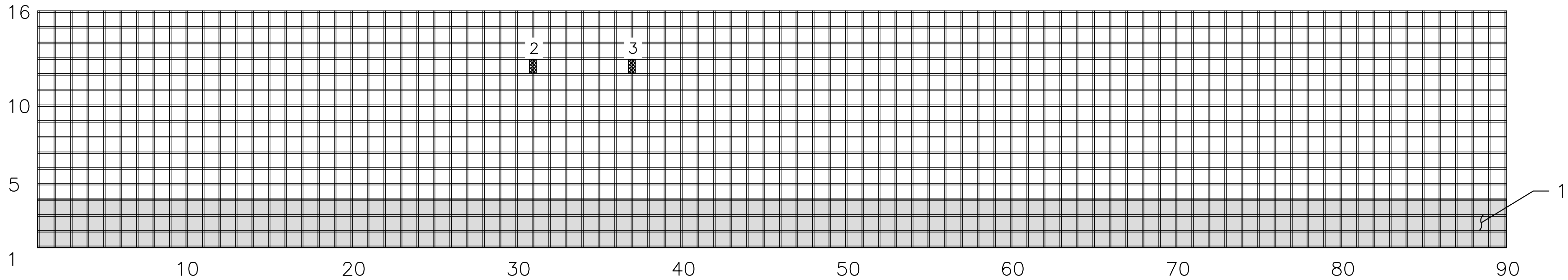
drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	48 OF 65 — drawing no. / dessine no.
tender soumission / project manager administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12-14.dwg

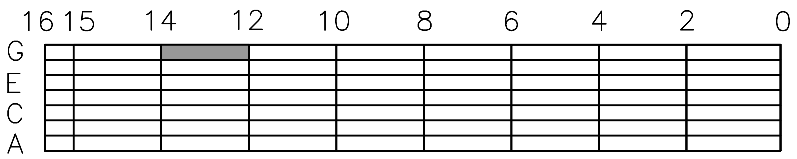
DATE PLOTTED: Monday, February 22, 2021 9:42:30 AM



12–14 – G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR



GSC-A3A 95-09

Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO
DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN
drawn by / dessine par

SW
designed by / conc par

PH
approved by / approuve par

tender / soumission
project manager / administrateur de projets

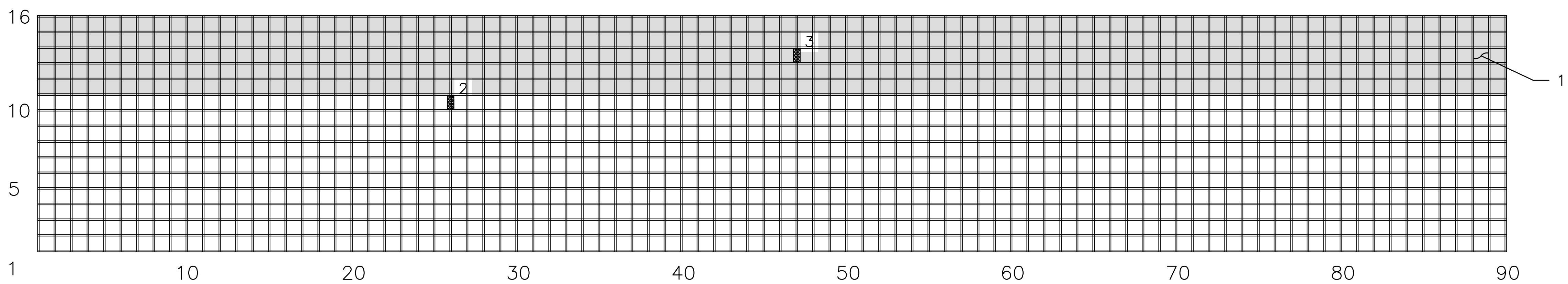
FEBRUARY 2021
project date / date du projet

R.090045.001
project no. / no. du projet

49 OF 65
drawing no. / dessine no.

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 12–14.dwg

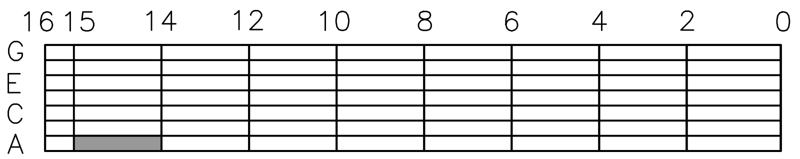
DATE PLOTTED: Monday, February 22, 2021 9:42:34 AM



14–15 – A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR AND CRACKED WELDS



GSC-A3A 95-09

Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

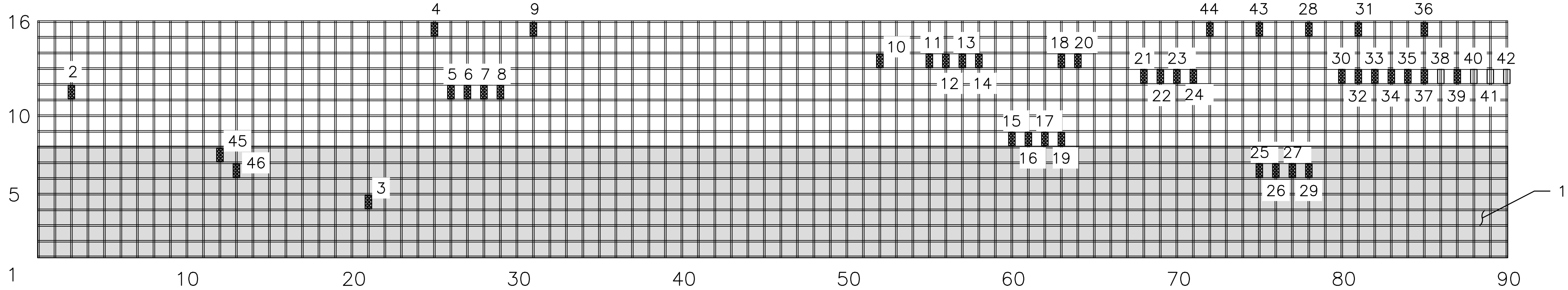
drawing title
titre du dessin

BRIDGE GRATING
DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	50 OF 65 drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14–15.dwg

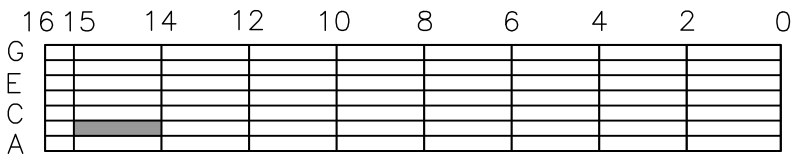
DATE PLOTTED: Monday, February 22, 2021 9:43:38 AM



14–15 – B

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	15	BENT TRANSVERSE BAR	29	BENT TRANSVERSE BAR	43	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR	16	BENT TRANSVERSE BAR AND CRACKED WELD	30	BENT TRANSVERSE BAR	44	BENT TRANSVERSE BAR
3	BROKEN TRANSVERSE BAR	17	BENT TRANSVERSE BAR	31	BROKEN TRANSVERSE BAR	45	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR	18	BENT TRANSVERSE BAR	32	BENT TRANSVERSE BAR	46	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR	19	BENT TRANSVERSE BAR	33	BENT TRANSVERSE BAR		
6	BENT TRANSVERSE BAR	20	BENT TRANSVERSE BAR	34	BENT TRANSVERSE BAR		
7	BROKEN TRANSVERSE BAR	21	BENT TRANSVERSE BAR	35	BENT TRANSVERSE BAR		
8	BENT TRANSVERSE BAR	22	BENT TRANSVERSE BAR	36	BENT TRANSVERSE BAR		
9	BENT TRANSVERSE BAR	23	BENT TRANSVERSE BAR	37	BENT TRANSVERSE BAR		
10	BENT TRANSVERSE BAR	24	BENT TRANSVERSE BAR	38	REPAIRED STEEL BAR		
11	BENT TRANSVERSE BAR	25	BENT TRANSVERSE BAR	39	BENT TRANSVERSE BAR		
12	BENT TRANSVERSE BAR	26	BENT TRANSVERSE BAR	40	REPAIRED STEEL BAR		
13	BENT TRANSVERSE BAR	27	BENT TRANSVERSE BAR	41	REPAIRED STEEL BAR		
14	BENT TRANSVERSE BAR	28	BENT TRANSVERSE BAR	42	REPAIRED STEEL BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

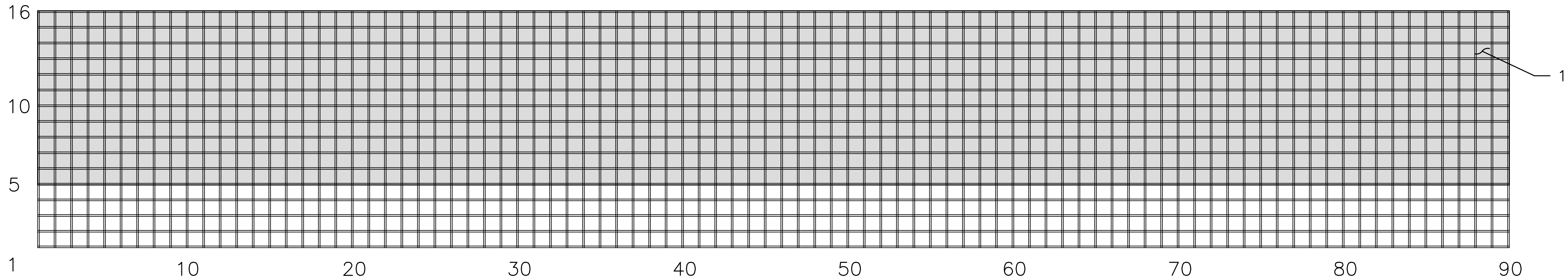
TN drawn by / dessine par
SW designed by / conc par
PH approved by / approuve par
tender soumission / project manager administrateur de projets

FEBRUARY 2021 project date / date du projet
R.090045.001 project no. / no. du projet
51 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14-15.dwg

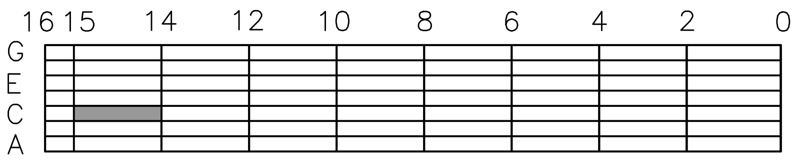
DATE PLOTTED: Monday, February 22, 2021 9:43:43 AM



14–15 – C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

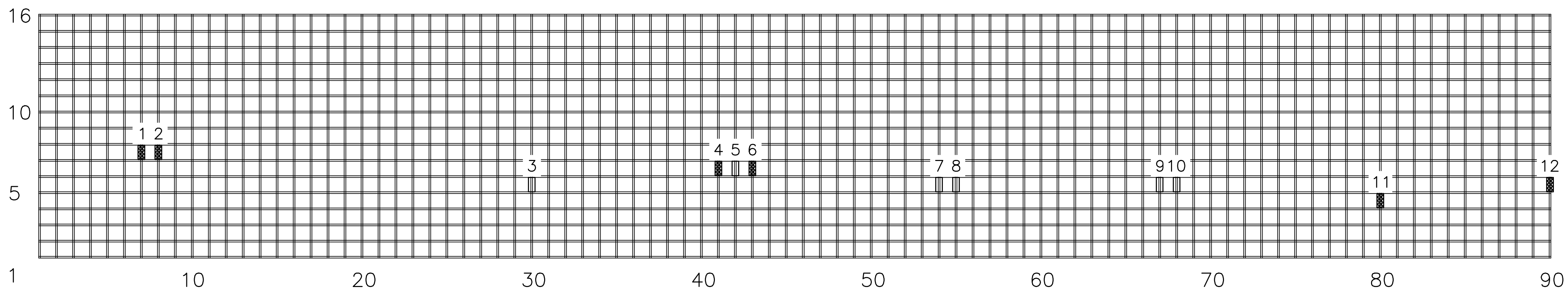
drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN drawn by dessine par	FEBRUARY 2021 project date date du projet
SW designed by conc par	R.090045.001 project no. no. du projet
PH approved by approuve par	52 OF 65 drawing no. dessine no.
tender soumission project manager administrateur de projets	

GSC–A3A 95–09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14–15.dwg

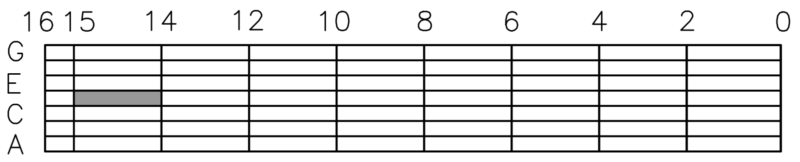
DATE PLOTTED: Monday, February 22, 2021 9:43:46 AM



14–15 – D

1:20

DEFECT No.	DESCRIPTION
1	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR
3	REPAIRED STEEL BAR
4	BENT TRANSVERSE BAR
5	REPAIRED TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	REPAIRED STEEL BAR
8	BENT TRANSVERSE BAR
9	REPAIRED STEEL BAR
10	REPAIRED STEEL BAR
11	BENT TRANSVERSE BAR
12	BENT TRANSVERSE BAR



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN
drawn by dessine par

SW
designed by conc par

PH
approved by approuve par

tender
soumission
project manager
administrateur de projets

FEBRUARY 2021
project date date du projet

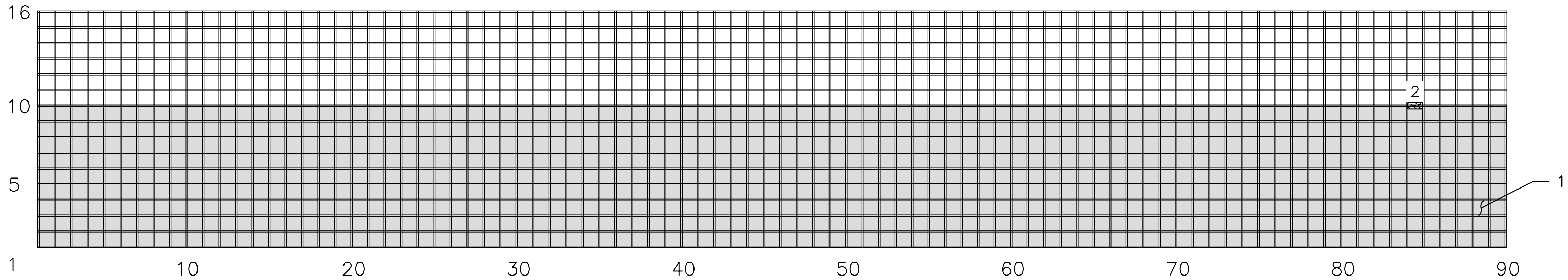
R.090045.001
project no. no. du projet

53 OF 65
drawing no. dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14-15.dwg

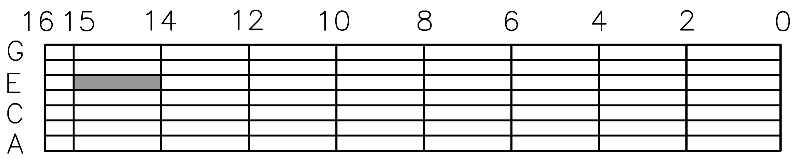
DATE PLOTTED: Monday, February 22, 2021 9:43:51 AM



14-15 - E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	CRACKED WELD ON SILL



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN
drawn by dessine par

SW
designed by conc par

PH
approved by approuve par

tender soumission project manager administrateur de projets

FEBRUARY 2021
project date date du projet

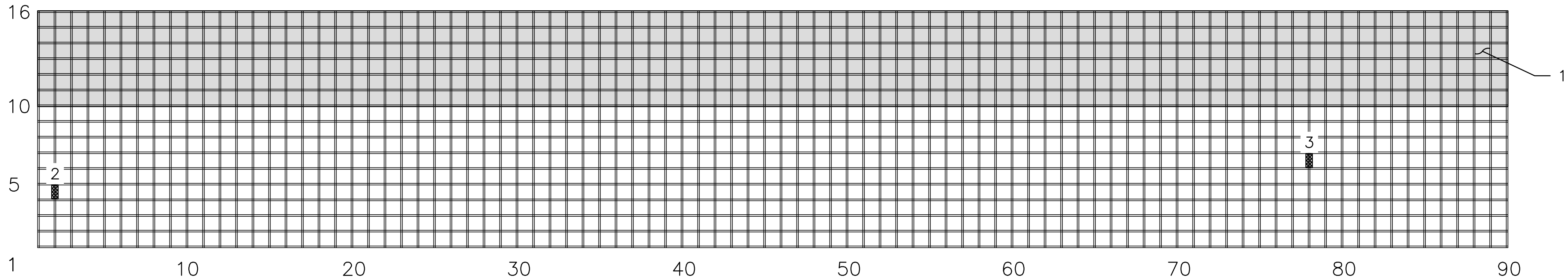
R.090045.001
project no. no. du projet

54 OF 65
drawing no. dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14-15.dwg

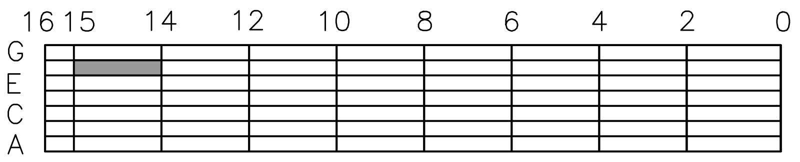
DATE PLOTTED: Monday, February 22, 2021 9:43:55 AM



14–15 – F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender / soumission — project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

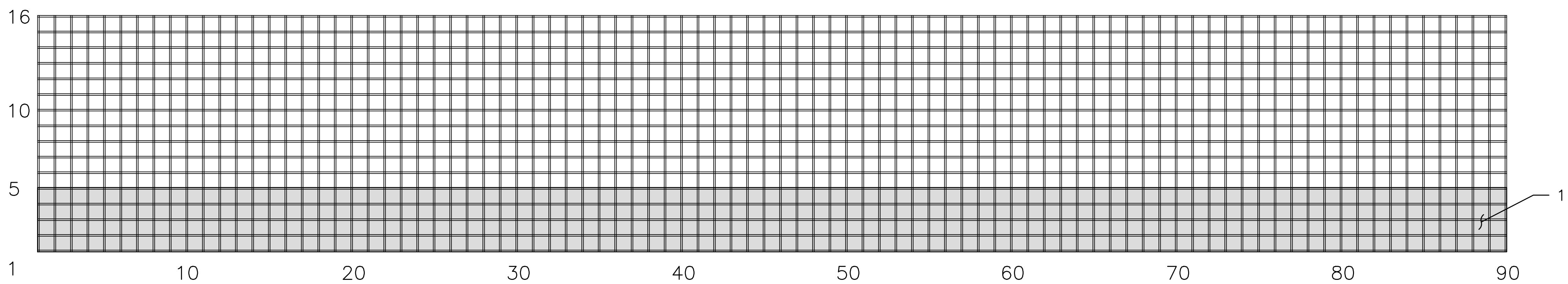
R.090045.001
project no. / no. du projet

55 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14-15.dwg

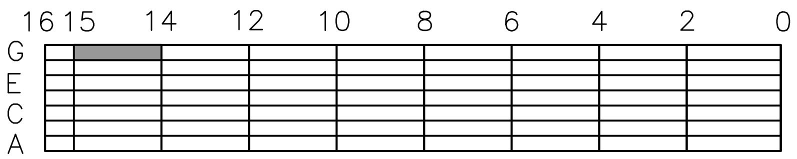
DATE PLOTTED: Monday, February 22, 2021 9:43:59 AM



14–15 – G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



GSC-A3A 95-09

Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets

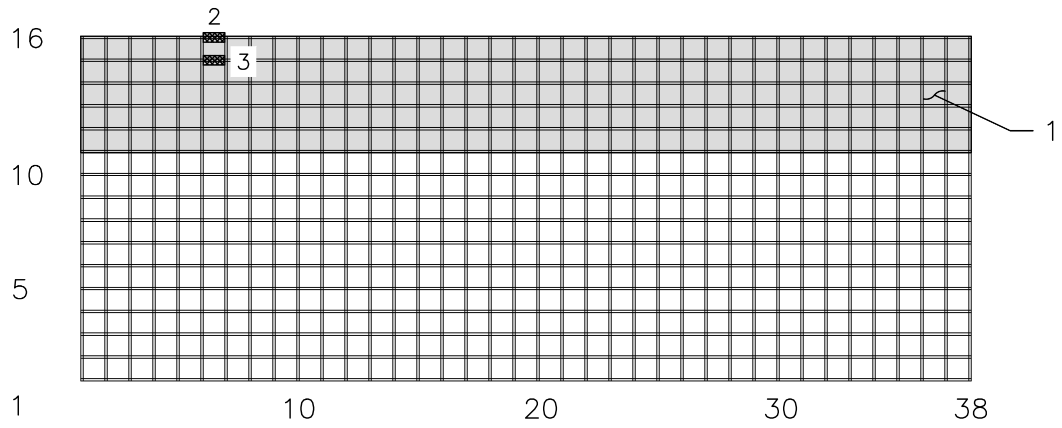
FEBRUARY 2021
project date / date du projet

R.090045.001
project no. / no. du projet

56 OF 65
drawing no. / dessine no.

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 14–15.dwg

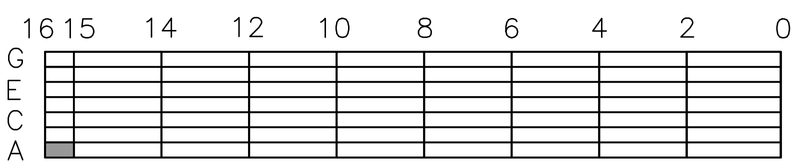
DATE PLOTTED: Monday, February 22, 2021 9:44:03 AM



15–16 — A

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	CRACKED LONGITUDINAL BAR
3	CRACKED LONGITUDINAL BAR



Public Works and
Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et
Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

BRIDGE GRATING
DETERIORATIONS

TN
drawn by dessine par

SW
designed by conc par

PH
approved by approuve par

tender soumission
project manager administrateur de projets

FEBRUARY 2021
project date date du projet

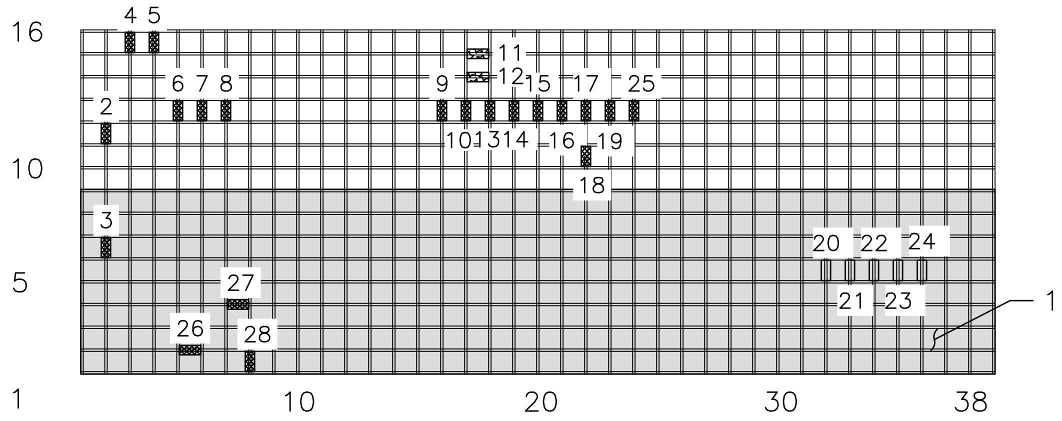
R.090045.001
project no. no. du projet

57 OF 65
drawing no. dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 15-16.dwg

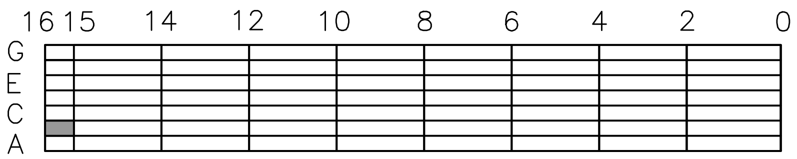
DATE PLOTTED: Monday, February 22, 2021 9:33:49 AM



15-16 - B

1:20

DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION	DEFECT No.	DESCRIPTION
1	WORN SERRATIONS	13	BENT TRANSVERSE BAR	25	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR	14	BENT TRANSVERSE BAR	26	CRACKED LONGITUDINAL BAR
3	BENT TRANSVERSE BAR	15	BENT TRANSVERSE BAR	27	CRACKED LONGITUDINAL BAR
4	BENT TRANSVERSE BAR	16	BENT TRANSVERSE BAR	28	CRACKED LONGITUDINAL BAR
5	BENT TRANSVERSE BAR	17	BENT TRANSVERSE BAR		
6	BENT TRANSVERSE BAR	18	BENT TRANSVERSE BAR		
7	BENT TRANSVERSE BAR	19	BENT TRANSVERSE BAR		
8	BENT TRANSVERSE BAR	20	REPAIRED STEEL BAR		
9	BENT TRANSVERSE BAR	21	REPAIRED STEEL BAR		
10	BENT TRANSVERSE BAR	22	REPAIRED STEEL BAR		
11	BROKEN LONGITUDINAL BAR	23	REPAIRED STEEL BAR		
12	BROKEN LONGITUDINAL BAR	24	REPAIRED STEEL BAR		



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

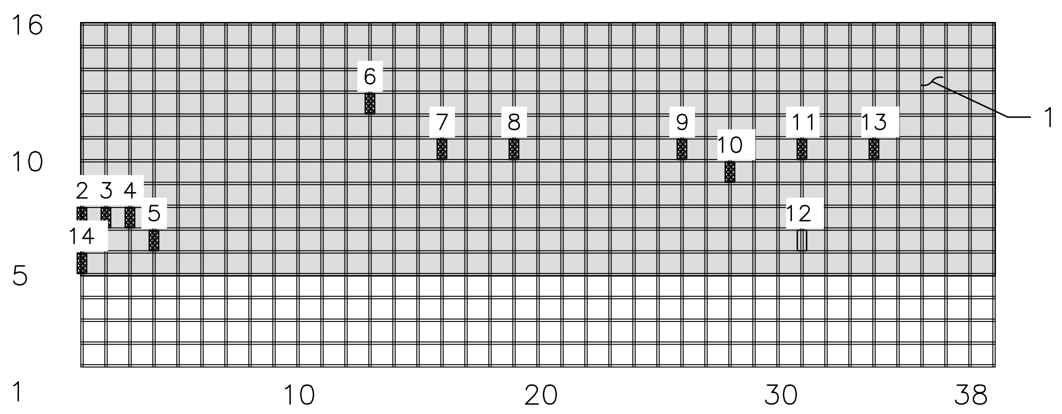
TN drawn by / dessine par
SW designed by / conc par
PH approved by / approuve par
tender soumission / project manager administrateur de projets

FEBRUARY 2021 project date / date du projet
R.090045.001 project no. / no. du projet
58 OF 65 drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 15-16.dwg

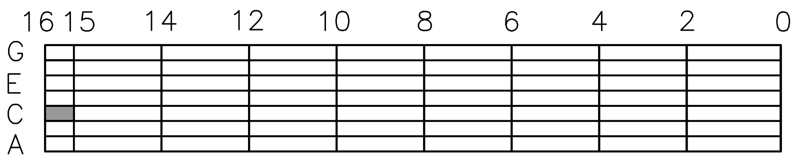
DATE PLOTTED: Monday, February 22, 2021 9:33:53 AM



15–16 – C

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BROKEN TRANSVERSE BAR
3	BROKEN TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR
10	BENT TRANSVERSE BAR AND CRACKED WELD
11	BENT TRANSVERSE BAR
12	REPAIRED STEEL BAR
13	BENT TRANSVERSE BAR
14	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

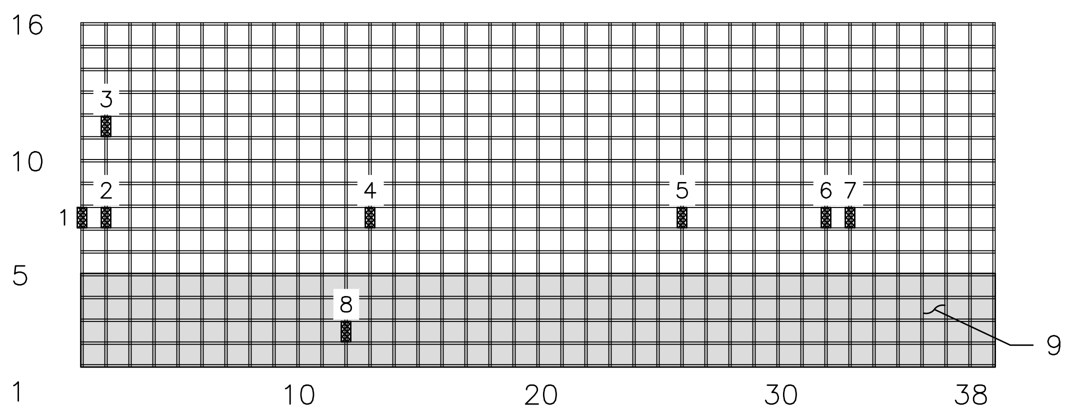
project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN — drawn by / dessine par	FEBRUARY 2021 — project date / date du projet
SW — designed by / conc par	R.090045.001 — project no. / no. du projet
PH — approved by / approuve par	59 OF 65 — drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

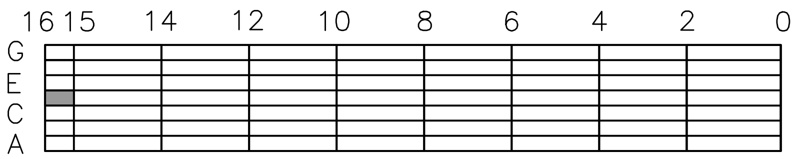
GSC-A3A 95-09



15–16 – D

1:20

DEFECT No.	DESCRIPTION
1	BENT TRANSVERSE BAR
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	MISSING BOLT AT SILL CONNENCTION
9	WORN SERATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY
BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING
DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
	tender soumission / project manager administrateur de projets

FEBRUARY 2021
project date / date du projet

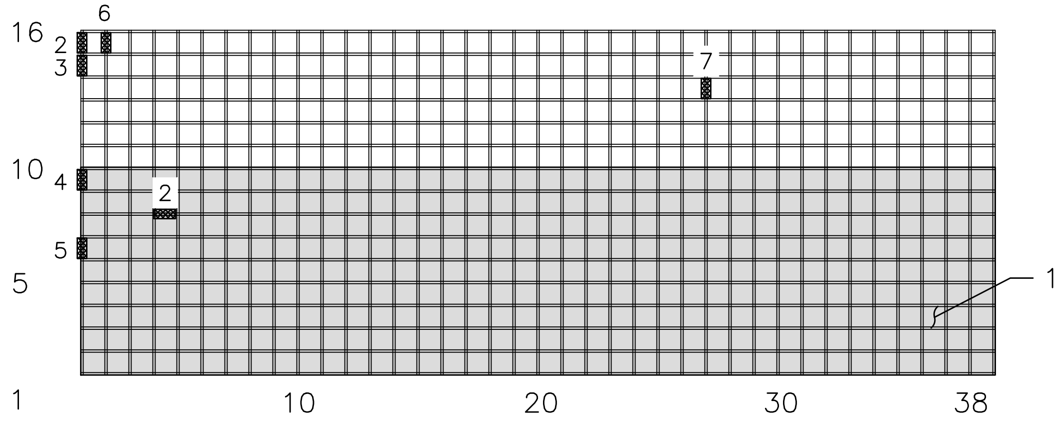
R.090045.001
project no. / no. du projet

60 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 15-16.dwg

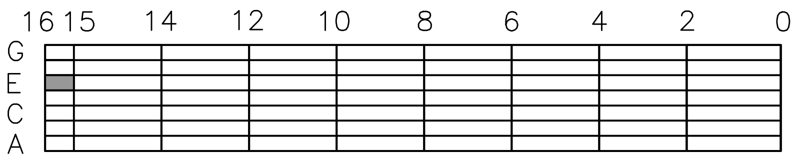
DATE PLOTTED: Monday, February 22, 2021 9:34:01 AM



15–16 – E

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR WITH CRACK
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN	drawn by / dessine par
SW	designed by / conc par
PH	approved by / approuve par
tender / soumission	project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

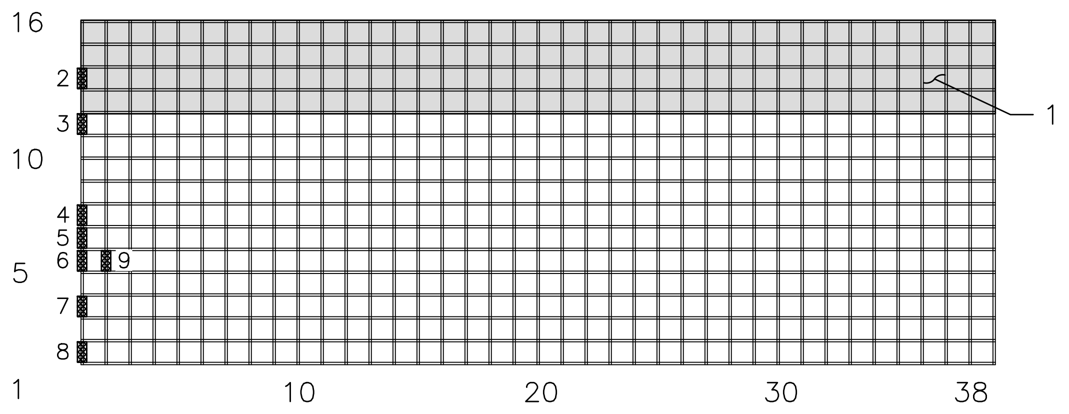
R.090045.001
project no. / no. du projet

61 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 15-16.dwg

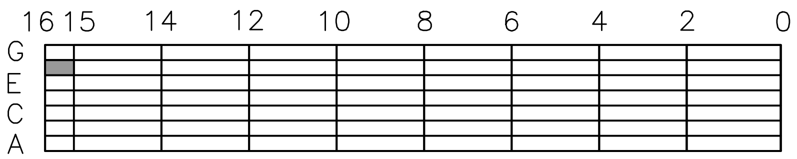
DATE PLOTTED: Monday, February 22, 2021 9:34:05 AM



15–16 – F

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS
2	BENT TRANSVERSE BAR
3	BENT TRANSVERSE BAR
4	BENT TRANSVERSE BAR
5	BENT TRANSVERSE BAR
6	BENT TRANSVERSE BAR
7	BENT TRANSVERSE BAR
8	BENT TRANSVERSE BAR
9	BENT TRANSVERSE BAR



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title
titre du projet

LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO

DECK GRATING REPAIRS

drawing title
titre du dessin

BRIDGE GRATING DETERIORATIONS

TN
drawn by / dessine par

SW
designed by / conc par

PH
approved by / approuve par

tender / soumission — project manager / administrateur de projets

FEBRUARY 2021
project date / date du projet

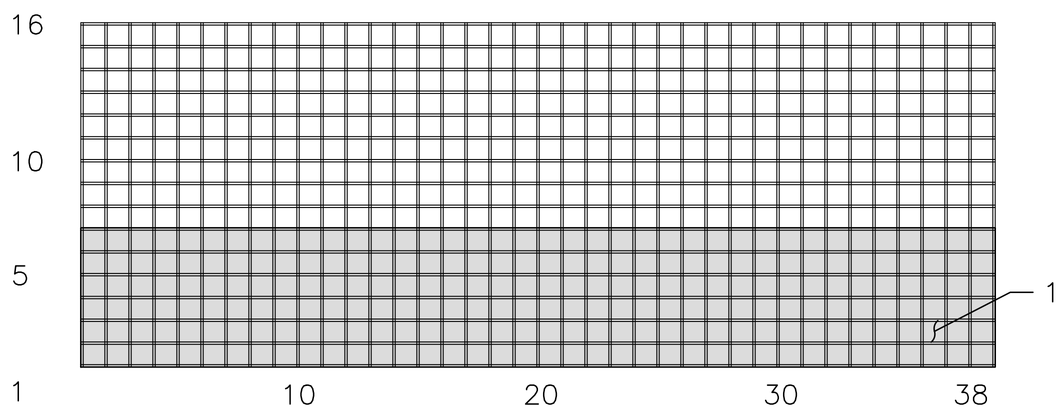
R.090045.001
project no. / no. du projet

62 OF 65
drawing no. / dessine no.

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 15-16.dwg

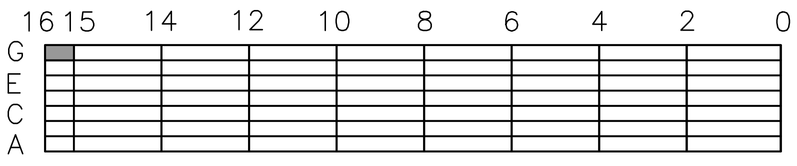
DATE PLOTTED: Monday, February 22, 2021 9:34:09 AM



15-16 - G

1:20

DEFECT No.	DESCRIPTION
1	WORN SERRATIONS



Public Works and Government Services Canada
Architectural and Engineering Services
Ontario Region

Travaux publics et Services gouvernementaux Canada
Services d'architecture et de génie
Région de l'Ontario

project title / titre du projet
LASALLE CAUSEWAY BASCULE BRIDGE
KINGSTON
ONTARIO
DECK GRATING REPAIRS

drawing title / titre du dessin
BRIDGE GRATING DETERIORATIONS

TN drawn by / dessine par	FEBRUARY 2021 project date / date du projet
SW designed by / conc par	R.090045.001 project no. / no. du projet
PH approved by / approuve par	63 OF 65 drawing no. / dessine no.
tender / soumission — project manager / administrateur de projets	

GSC-A3A 95-09

CAD FILE: H:\ISO\477214\1000\DWGS\Bascule Bridge\Grating Dwgs\Bascule Bridge Deck Inspection GRATING 15-16.dwg

DATE PLOTTED: Monday, February 22, 2021 9:34:13 AM

APPENDIX H – EAST APPROACH AND ABUTMENT SURVEY

LaSalle Causeway Bascule Bridge - East Approach and Abutment Survey

Monitoring Point No.	Northing	Easting	Oct. 3, 2018 Elev. (m)	Oct. 25, 2019 Elev. (m)					
1	4899416.8	306862.3	74.942	74.947					
2	4899417.1	306865.1	76.826	76.831					
3	4899415.2	306866.2	76.828	76.834					
4	4899415.7	306869.6	76.766	76.771					
5	4899416.4	306873.9	76.684	76.689					
6	1899412.6	306874.9	76.686	76.691					
7	4899411.6	306866.6	76.849	76.854					
8	4899407.7	306866.7	76.877	76.883					
9	4899408.1	306870.4	76.797	76.802					
10	4899408.6	306874.9	76.621	76.626					
11	4899406.4	306875.1	76.794	76.799					
12	4899405.7	306866.9	77.079	77.085					
13	4899404.9	306864.7	74.943	74.948					

Notes: Baseline datum established from 3 level loops

Coordinate Values NAD83/3°MTM/CSRS 1997

Elevations related to First Order vertical control monument 009182U097

AOV Ref.: 17478-18

SURVEYING
ANNIS
O'SULLIVAN
VOLLEBEKK

October 29, 2018

Parsons Inc.
1223 Michael St, Suite 100
Ottawa, ON
K1T 7T2

Attn: Mr. Peter Harvey P.Eng.
Structural Engineer

Re: LaSalle Causeway Bascule Bridge Monitoring
City of Kingston
Our Reference: 17478-18

Dear Sir,

The enclosed elevation spreadsheet provides the base data to compare future monitoring sessions to. The base elevations are determined/verified by three distinct measurement sessions completed October 3, 2018. The maximum deviation from the mean elevation of any elevation over the three sessions was 0.001 metres. All monitoring points are on the outer concrete surface identified by the cross cut into the concrete surface.

All elevations are related to provincial benchmark 0011968U301; a copy of the benchmark description is attached.

Should you have any questions concerning this matter, please do not hesitate to contact me.

Yours truly,

E. H. Herweyer
Ontario Land Surveyor
Direct Line: 613-727-0934

EHH:jm
Encl.

ONTARIO LAND SURVEYORS
A.J. Broxham
R.R. Gauthier
E.H. Herweyer
E.M. Lancaster
G.A. Ray
A.R. Roy
V.A. Shelp
D.R. Vollebekk

G.D. Annis (1939-2013)

DEVELOPMENT
R.F. Robinson

CONDOMINIUMS
A.Z. Pichette

OTTAWA ❑
14 Concourse Gate
Suite 500
Nepean, Ontario
K2E 7S6
613 727-0850
613 727-1079 Fax
nepean@aovltd.com

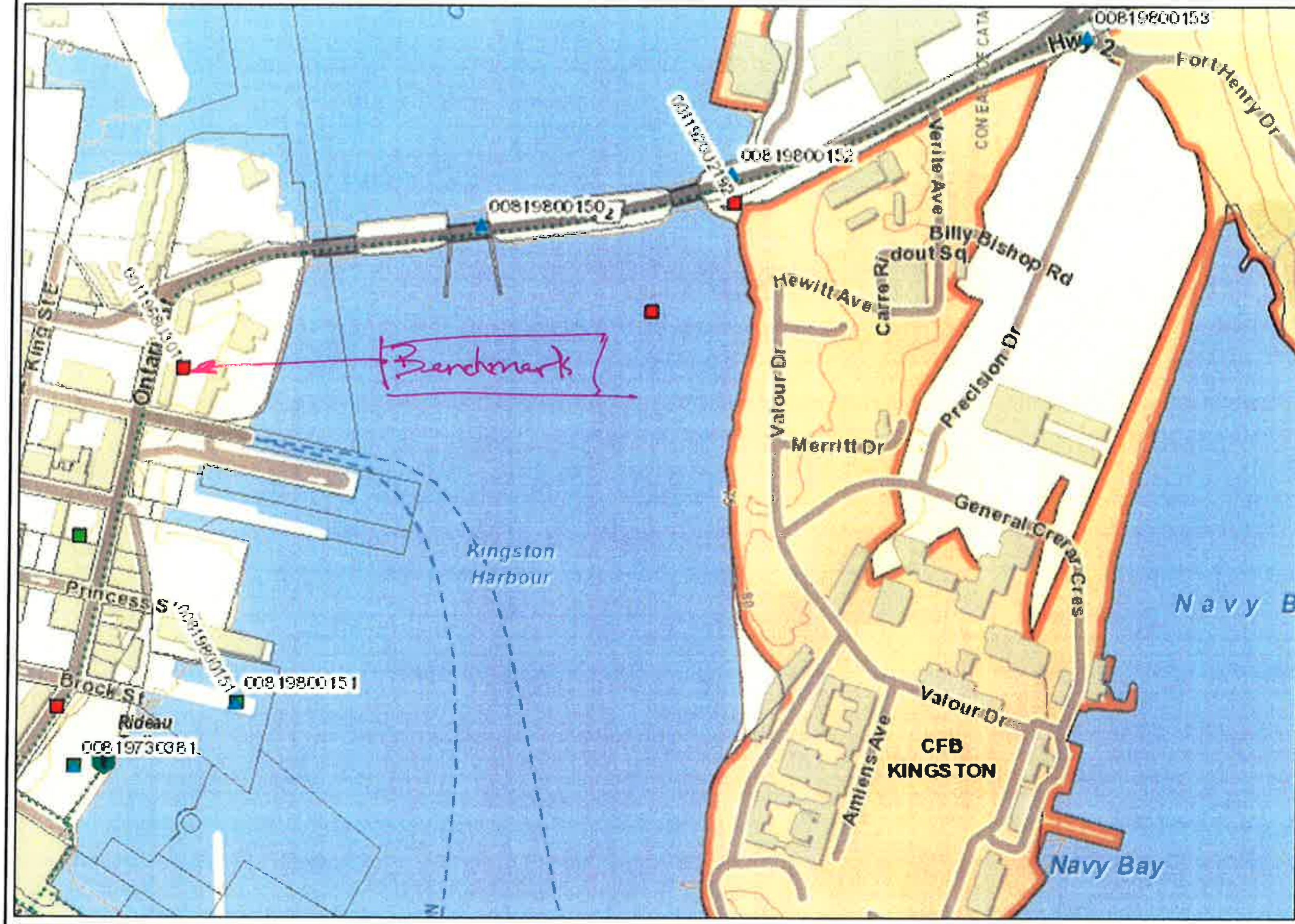
EMBRUN (Russell) ❑
225 Industriel Street
PO Box 579
Embrun, Ontario
K0A 1W0
613 443-3364
613 443-3229 Fax
embrun@aovltd.com

STATION: 0011968U301

Also known as:	00168U301, 68U301, CP82204, V00168U301
Monument status:	Existing
Monument type:	CAP
Station type:	SPIR
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N44 °13 ′59.9xxxx ″
Longitude:	W76 °28 ′41.9xxxx ″
Ellipsoidal elevation:	
Ellipsoidal elevation order:	
UTM-18 Easting:	E381941.xxx
UTM-18 Northing:	N4898851.xxx
UTM-18 Cmbd sc-fact:	0.99977141
UTM-18 Mrdnl convg:	-1 °01 ′53.0 ″
MTM-9 Easting:	E306530.xxx
MTM-9 Northing:	N4899259.xxx
MTM-9 Cmbd sc-fact:	0.99990003
MTM-9 Mrdnl convg:	0 °00 ′54.4 ″
Vertical datum:	CGVD2013
Vertical accuracy:	First order
Orthometric elev:	76.473
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: KINGSTON NORMANDY HALL, A LARGE TWO-STOREY BUILDING ON NORTH SIDE OF HIGHWAY NO. 2, 0.3 KM WEST OF CENTRE OF LASALLE CAUSEWAY, 0.5 KM EAST OF PRINCESS STREET, TABLET IN EAST CONCRETE FOUNDATION WALL, 1.43 M FROM SOUTHEAST CORNER AND 61 CM BELOW TOP.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	**CGVD-1928:1978** [1]
Networks [usage]:	0200V [FIX]
Number of Ref Sketches:	0

Enter map title

Notes:
Enter map notes



Legend

Horizontal Stations
- First Order
- Second Order
- Third Order
- Fourth Order
- Toronto Third Order

Vertical Stations
- First Order
- Second Order
- Third Order
- Fourth Order
- Toronto Vertical Third Order

Unknown or Missing Stations
- Destroyed/Unknown Stations

NAD83-CSRS Stations
- Class A
- Class B
- Class C
- Class D
- Class E
- Class A with Other Horizontal
- Class B with Other Horizontal
- Class C with Other Horizontal
- Class D with Other Horizontal
- Class E with Other Horizontal

RTK Providers
- Leica SmartNet Stations
- Cansel Can-Net Stations
- Topcon TopNET Live Stations

- Assessment Parcel
- Geographic Township

0 0.3 km

Projection: Web Mercator

The Ontario Ministry of Natural Resources and Forestry shall not be liable in any way for the use of, or reliance upon, this map or any information on this map. This map should not be used for: navigation, a plan of survey, routes, nor locations.

Imagery Copyright Notices: Ontario Ministry of Natural Resources and Forestry; NASA Landsat Program; First Base Solutions Inc.; Aéro-Photo (1961) Inc.; DigitalGlobe Inc.; U.S. Geological Survey.

JOB NUMBER 17472-18

VALUABLE FIELD NOTES
Please return to Surveyor

ANNIS O'SULLIVAN, VOLLEBEKK LTD.

ONTARIO LAND SURVEYORS

14 Concourse Gate, Suite 500, Ottawa, Ontario K2E 7S6
225 Rue Industriel, Box 579, Embrun, Ontario K0A 1W0

LOCATION/ADDRESS: LASALLE CAUSEWAY

Page of

LOT: | PLAN: | CON:

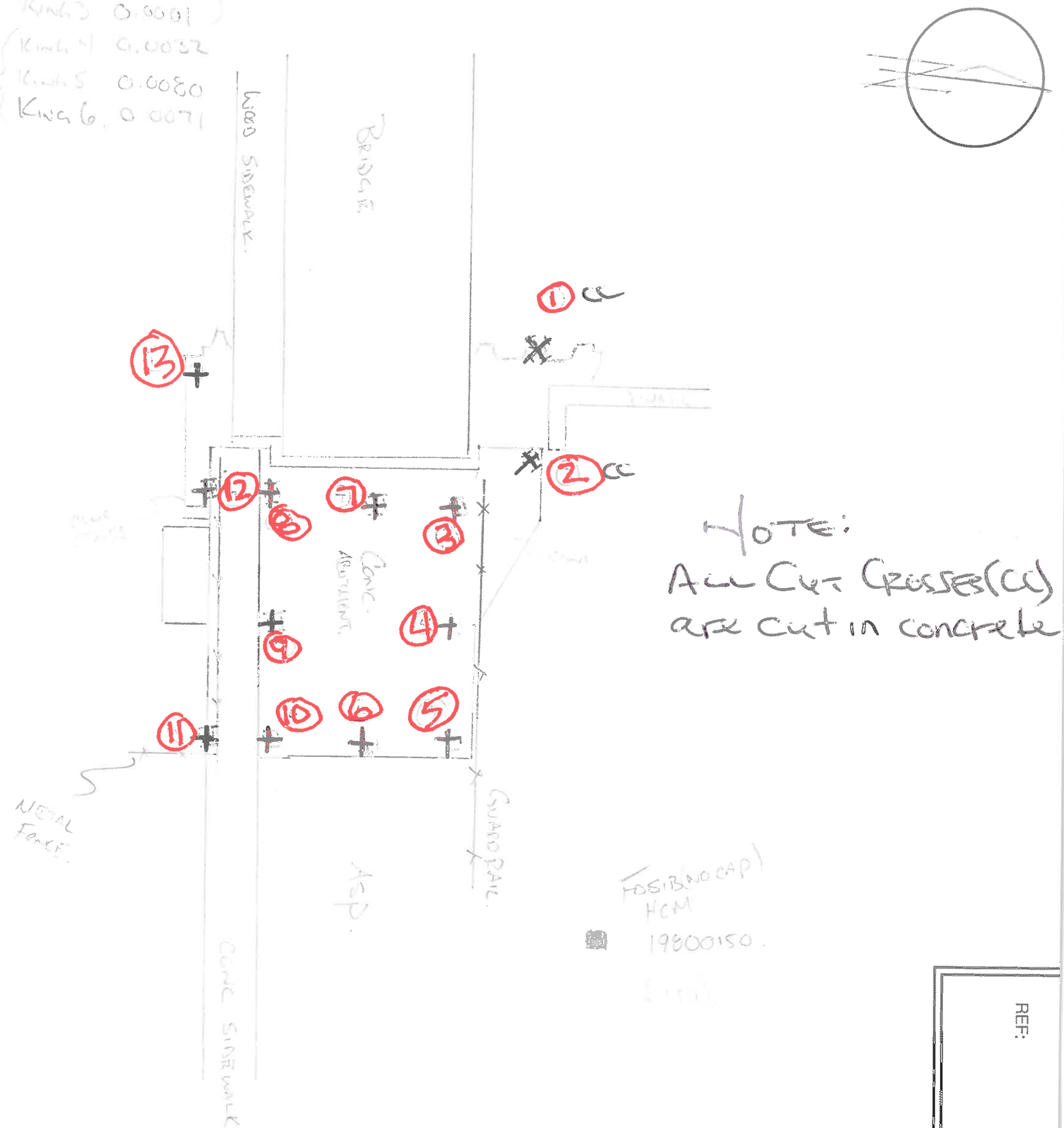
TOWNSHIP: KINGSTON | DATE: OCT 31 18

TEMP: | FIELD PARTY: HILL EDWARDS

OCT31 18 King 1 0.000 } ASSUME
King 2 0.0000
King 3 0.0001

OFF B.M. 301 { King 4 0.0032
King 5 0.0080
King 6 0.0071

BM 1968U301 (301).
76.473 M



NOTE:
ALL CUT CROSSES (CC)
are cut in concrete

REF:

APPENDIX I – MECHANICAL ROOM CONCRETE SLAB – LIMITED CONDITION SURVEY REPORT

LIMITED CONDITION SURVEY REPORT

Your Bridge & Concrete Inspection Specialists

LaSalle Causeway Bascule Bridge - Concrete Slab for Machinery Room, Kingston, ON

Prepared for: PARSONS

BCC Project No.: BCC19051
Report Date: September 17, 2019

Bridge Check Canada Ltd.
200 Viceroy Road, Unit 4, Vaughan, ON L4K 3N8
T 905-660-6608 F 905-660-6608
www.bridgecheckcanada.com

TABLE OF CONTENTS

Structure Identification Sheet

STRUCTURE IDENTIFICATION SHEET

GENERAL INFORMATION

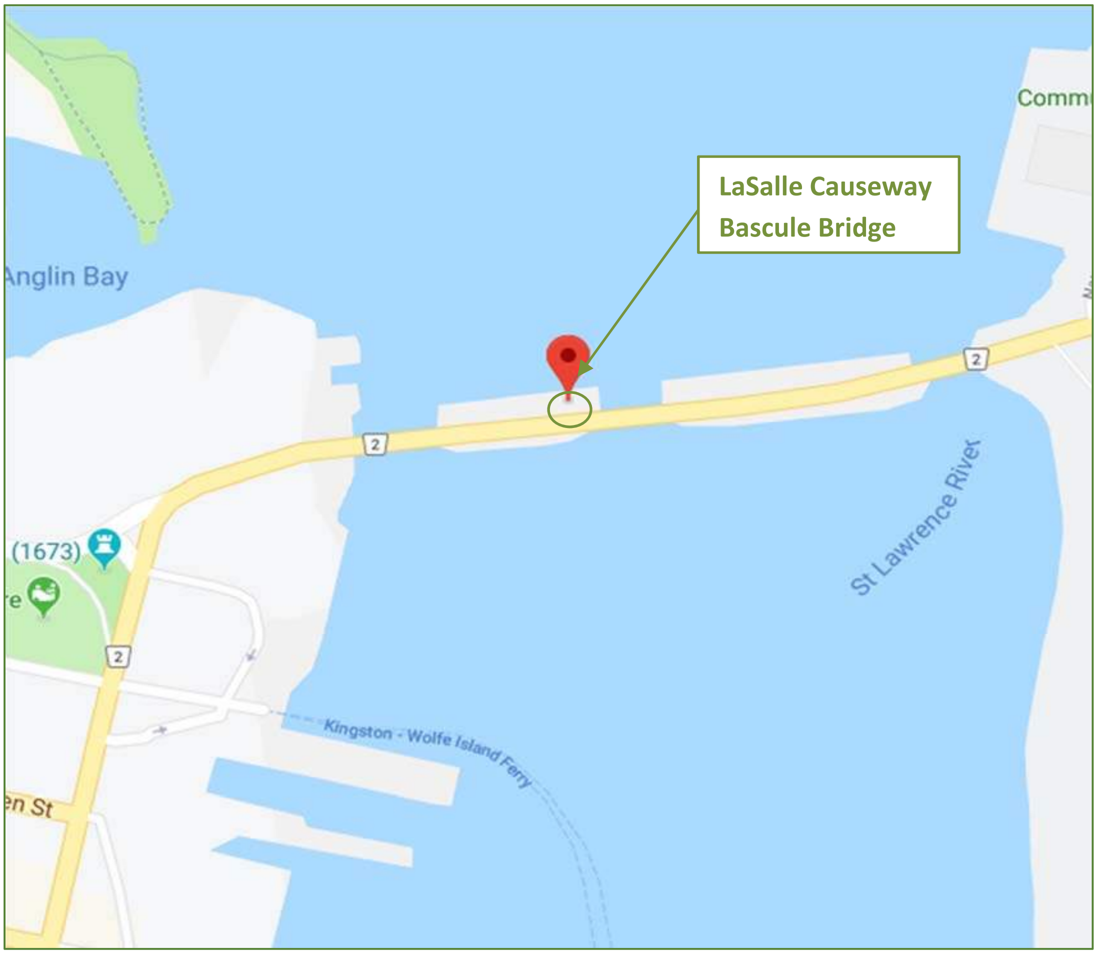
STRUCTURE NAME	***LaSalle Causeway Bascule Bridge***		
SITE NUMBER	Machinery Room	**DISTRICT NUMBER**	N/A
HIGHWAY **above**	N/A	**Below**	N/A
TYPE OF STRUCTURE	Reinforced cast-in-place concrete slab		
NUMBER OF SPANS	N/A	**SPAN LENGTHS**	N/A
ROADWAY WIDTH	N/A	**YEAR BUILT**	
DIRECTION OF STRUCTURE	N/A		
SEQUENCE NUMBER	N/A	**TOWNSHIP NUMBER**	N/A
LHRS NUMBER	N/A	**MUNICIPAL BRIDGE NUMBER**	N/A
LOCATION	LaSalle Causeway Bascule at St. Lawrence River, Kingston	**JURISDICTION**	City of Kingston
INSPECTOR'S NAME	Mohammad Abdollahi, P.Eng.		
PARTY MEMBERS	A. Rashid, E. Elsayed, J. Murray		
DATE OF INSPECTION	18-Aug-19		
TEMPERATURE	21 °C	**WEATHER**	clear
MTO REGION	Eastern	**AADT**	
DECK RIDING SURFACE	Exposed concrete slab		
YEAR LAST REHABILITATED	N/A		

ENGINEER'S STAMP

Key Plan

KEY PLAN

LaSalle Causeway Bascule Bridge
Kingston, ON



200 Viceroy Road, Unit 4, Vaughan, ON L4K 3N8
www.bridgecheckcanada.com
Tel: 905-660-6608 Fax: 905-660-6609
info@bridgecheckcanada.com

Summary of Significant Findings

SUMMARY OF SIGNIFICANT FINDINGS

LaSalle Causeway Bascule Bridge – Machinery Room Slab, Kingston, ON

1.0 INTRODUCTION

Bridge Check Canada Ltd. was retained by Parsons Inc. to carry out a limited condition survey of the Machinery Room slab at the LaSalle Causeway Bascule Bridge in Kingston, ON. This report presents *Bridge Check Canada Ltd.*'s findings, through the field investigations and laboratory testing. Field investigations were carried out on August 18, 2019. The scope of work for *Bridge Check Canada Ltd*. was limited to performing visual, surface deterioration, delamination, concrete cover and corrosion potential surveys of the machinery room slab (soffit); and visual, surface deterioration and delamination surveys of the slab (topside). Our scope of work also included laboratory testing of the field cores.

LaSalle Causeway Bascule Bridge – Machinery Room

2.0 METHODOLOGY

In general, the procedures followed to conduct the condition survey and delamination survey were those defined in Part 1 of the MTO Structure Rehabilitation Manual (2007). This assignment involved the observation and recording of surface defects, delamination detection, grid layout, concrete cores (75 mm ø), corrosion potential survey, covermeter survey and physical testing of the concrete cores.

The delaminations in the concrete were detected by striking the surface with a heavy hammer and noting the type of sound being emitted. Note that, while this method is quite reliable, it may not detect delaminations at a depth greater than 100 mm. The hammer sounding method was used for all accessible vertical and vertical surfaces. The areas and locations of patches, spalls, delaminations, exposed reinforcement, honey-combing, wet areas, scaling and other observed defects were recorded.

A corrosion potential survey was conducted for the slab (soffit), in accordance with the requirements of ASTM C876 and the MTO Structure Rehabilitation Manual. A positive ground connection was made directly to the reinforcing steel, at the locations shown on the accompanying drawings.

Seven (7) cores (4 from soffit and 3 from topside of slab) were extracted from the machinery room slab. The inside of the coreholes were examined carefully for cracks and the condition of the concrete.

Enclosed with this report are detailed condition survey summary sheets, survey equipment and calibration procedures, core photos/sketches, core logs, site photos, laboratory test results and drawings.

3.0 SUBSTRUCTURE COMPONENTS

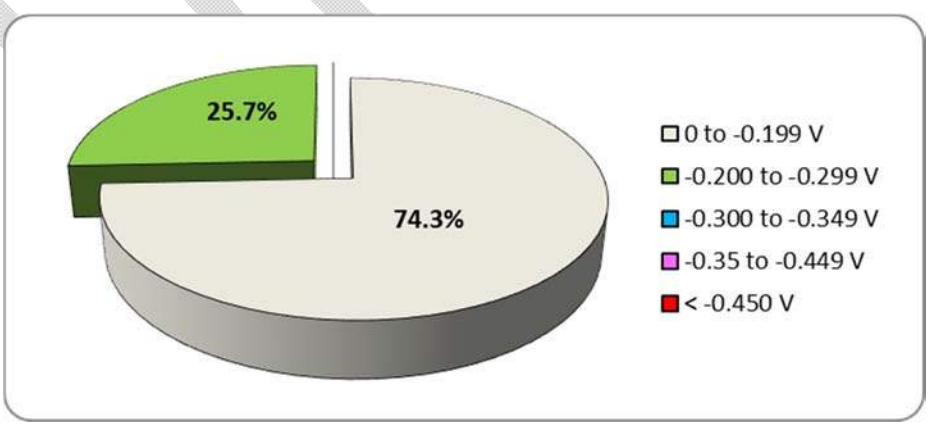
3.1 Machinery Room Slab (Soffit)

The machinery room slab (soffit), with a total surveyed area of 39.00 m^2, was in fair-to-poor condition with clean medium width cracks (5.0 m), delaminations (1.55 m^2), spalls (0.65 m^2), honeycombing (0.28 m^2) and light/medium scaling (16.50, 1.455 m^2). The typical condition of the slab (soffit) is shown in Photos P2 to P12, and on Drawing No. 1.

Cores C1 to C4 were extracted from the slab (soffit). The concrete in the cores was in good condition. Photos P17 and P18 show the inside of the coreholes at Cores C1 and C2. Refer to the core logs and photos for more details.

The concrete cover to the outer rebar layer ranged from 28 to 49 mm with an average cover of 32 mm, as shown in Drawing No. 2.

Corrosion potential values obtained from the half-cell test carried out on the slab (soffit) ranged from -0.110 V to -0.245 V with an average value of -0.152 V. The half-cell survey indicated uncertain low corrosion activity for 25.7% (25.7%+0.0%) of the slab (soffit), with values ranging from -0.200 V to -0.349 V. Drawing 2 shows the corrosion potential readings on the slab (soffit).



Corrosion Potential Distribution on Slab (Soffit)

Core C1 was tested for compressive strength of the hardened concrete in accordance with CSA A23.2-14-14C. The compressive strength of the hardened concrete for this core was found to be 19.5 MPa.

The chloride ion content was tested on Core C2 using MTO LS-417 "Method of Test for Determination of Total Chloride Ion in Concrete – Acid Soluble". The chloride ion content value, at the average concrete cover is summarized below.

Core No.	**C2**
Corrected Chloride Content (%)*	0.023

* Background chloride ion content was estimated to be 0.006%.

The chloride threshold value necessary to depassivate embedded steel and to allow the onset of corrosion (in the presence of oxygen and moisture) is generally taken as 0.025% by mass of concrete. The background chloride content is the lowest chloride content value for all of the cores tested for chloride content. The "background" chlorides do not contribute to corrosion, and thus the results are corrected for the background chloride content. The corrected chloride content, at the rebar level, was above the chloride threshold level of 0.025% in the upper 0-10mm only (from the soffit).

3.2 Machinery Room Slab (topside)

The machinery room slab (topside), with a total surveyed area of 34.20 m^2, was in good condition exhibiting light scaling (8.61 m^2). The typical condition of the slab (topside) is shown in Photos P13 to P16, and on Drawing No. 1.

Cores C5 to C7 were extracted from the slab (topside). The concrete in the cores was in good condition. Photos P19 and P20 show the inside of the coreholes at Cores C6 and C6. Refer to the core logs and photos for more details.

The chloride ion content was tested on Core C7. The chloride ion content value, at the average concrete cover is summarized below.

Core No.	**C7**
Corrected Chloride Content (%)*	0.010

* Background chloride ion content was estimated to be 0.006%.

The corrected chloride content, at the rebar level, was below the chloride threshold level of 0.025% throughout the depths tested.

Appendix A:

Detailed Condition Survey Summary Sheets

Exposed Concrete Components

EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Curbs, Medians, Sidewalks, Barrier/Parapet Walls, etc.): Use separate form for each component

Site No: **Machinery Room**

Component Type & Location: Machinery Room Slab (topside) **OSIM Identifier: Decks**

1. Dimensions and Area

Width - Length - Height -

Diameter - Total Area Surveyed 34.20 m^2

Remarks

Dimensions were taken from the structural drawings & site measurements

2. Cracks (medium and wide)

Type		Transverse	Longitudinal	Other	Total	
Medium Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		
Wide Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction 0.0 m^2

4. Concrete Cover

Minimum	Maximum	Average	
-	-	-	mm

0 – 20 mm	-	**40 – 60 mm**	-	m^2
	-		-	%
20 – 40 mm	-	**over 60 mm**	-	m^2
	-		-	%

Remarks

Table # 4 is Not Applicable.

EXPOSED CONCRETE COMPONENTS

Site No: Machinery Room

Component Type & Location: Machinery Room Slab (topside) **OSIM Identifier: Decks**

Remarks

Table # 5 is Not Applicable.

5. Corrosion Activity

Minimum	Maximum	Average	
-	-	-	V

0 to -0.20	-0.20 to -0.30	-0.30 to -0.35	-0.35 to -0.45	< -0.45	V
-	-	-	-	-	m^2
-	-	-	-	-	%

Remarks

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m^2)	0.00	0.00	0.00
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤-0.35 V	
0.00 m^2	0.0 %	N/A	N/A

*Wet areas = 0.00 m^2

Remarks

7. Scaling

Light	Medium	Severe to Very Severe	
8.61	0.00	0.00	m^2
25.2	0.0	0.0	%

8. Honeycombing

Total Area 0.00 m^2

EXPOSED CONCRETE COMPONENTS

Site No: Machinery Room

Component Type & Location: Machinery Room Slab (topside) **OSIM Identifier: Decks**

Remarks
Table # 9 is Not Applicable.

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		0 to -0.20	-0.20 to -0.35	≤ -0.35
Chloride Content*	0-10 mm	-	-	-
	20-30 mm	-	-	-
	40-50 mm	-	-	-
	60-70 mm	-	-	-
	80-90 mm	-	-	-
	100-110 mm	-	-	-

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Rebar Level

Background chloride content = 0.006%

Core No.	C7	-	-	-	-	-
Chloride Content*	0.010	-	-	-	-	-

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

Remarks
Table # 11 is Not Applicable.

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

Site No: **Machinery Room**

Component Type & Location: Machinery Room Slab (topside)

OSIM Identifier: Decks

Remarks
Table # 12 is Not Applicable.

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained: not tested

14. Compressive Strength

Average Compressive Strength: not tested

EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Curbs, Medians, Sidewalks, Barrier/Parapet Walls, etc.): Use separate form for each component

Site No: **Machinery Room**

Component Type & Location: Machinery Room Slab (Soffit) **OSIM Identifier: Decks**

1. Dimensions and Area

Width - Length - Height -

Diameter - Total Area Surveyed 39.00 m^2

Remarks

Dimensions were taken from the structural drawings & site measurements

2. Cracks (medium and wide)

Type		Transverse	Longitudinal	Other	Total	
Medium Width	Clean	3.0	0.0	2.0	5.0	m
	Stained	0.0	0.0	0.0		
Wide Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction 0.0 m^2

4. Concrete Cover

Remarks

Minimum	Maximum	Average	
28	49	32	mm

0 – 20 mm	0.0	**40 – 60 mm**	2.2	m^2
	0.0		5.7	%
20 – 40 mm	36.8	**over 60 mm**	0.0	m^2
	94.3		0.0	%

EXPOSED CONCRETE COMPONENTS

Site No: **Machinery Room**

Component Type & Location: Machinery Room Slab (Soffit) **OSIM Identifier: Decks**

Remarks

5. Corrosion Activity

Minimum	Maximum	Average	
-0.110	-0.245	-0.152	V

0 to -0.20	-0.20 to -0.30	-0.30 to -0.35	-0.35 to -0.45	< -0.45	V
29.0	10.0	0.0	0.0	0.0	m^2
74.3	25.7	0.0	0.0	0.0	%

Remarks

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m^2)	1.55	0.65	0.00
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤-0.35 V	
2.20 m^2	5.6 %	0.0 m^2	0.0 %

*Wet areas = 0.00 m^2

7. Scaling

Remarks

Light	Medium	Severe to Very Severe	
16.50	1.45	0.00	m^2
42.3	3.7	0.0	%

8. Honeycombing

Total Area 0.28 m^2

EXPOSED CONCRETE COMPONENTS

Site No: Machinery Room

Component Type & Location: Machinery Room Slab (Soffit) **OSIM Identifier: Decks**

Remarks

9. Adjusted Chloride Content Profile

Background chloride content = 0.006%

Corrosion Activity at Core Location (volts)		0 to -0.20	-0.20 to -0.35	≤ -0.35
Chloride Content*	0-10 mm	0.033	-	-
	20-30 mm	0.023	-	-
	40-50 mm	0.018	-	-
	60-70 mm	0.020	-	-
	80-90 mm	0.014	-	-
	100-110 mm	0.014		
	120-130 mm	0.000	-	-

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Rebar Level

Core No.	C2	-	-	-	-	-
Chloride Content*	0.023	-	-	-	-	-

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

Remarks

Table # 11 is Not Applicable.

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

EXPOSED CONCRETE COMPONENTS

Site No: Machinery Room

Component Type & Location: Machinery Room Slab (Soffit) **OSIM Identifier: Decks**

Remarks
Table # 12 is Not Applicable.

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained: not tested

14. Compressive Strength

Average Compressive Strength: **19.5 MPa**

Appendix B:

Survey Equipment and Calibration Procedures

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Exposed Concrete Slab (Soffit) **Site Number:** LaSalle Causeway Bascule Bridge – Machinery Room Slab

1. Delaminations:

Weight of Chain: 2.2 **kg/m**
Other Equipment: Hammer

2. Concrete Cover:

Covermeter Make and Model: ELCOMETER Protovale 331

Battery Check:
- **Reading at Start of Test:** OK
- **Reading at End of Test:** OK

Concrete Cover Check:
- **Location of Check:** @ 'north-west'
- **Actual Depth and Rebar Diameter:** -
- **Reading Before Test:** 39 mm
- **Readings Each 30 minutes During Test:** 39 mm
- **Reading at End of Test:** 39 mm

3. Corrosion Activity:

Half Cell Make and Model: MC MILLER Electrode RE-3a (3" ø)
Multimeter Make and Model: Mastercraft Digital Multimeter 3R93
Length and Gauge of Lead Wires: 150 m of 18 gauge
Deck Temperature: **Start of Test:** 21 **°C** **End of Test:** 21 **°C**
Ambient Temperature: **Start of Test:** 21 **°C** **End of Test:** 21 **°C**
Battery Check: O.K.
Ground Check: **Method of Connection:** self-tapping screw
- **Ground Location:** @ soffit **Check Location:** @ soffit
- **Lead Resistance:** 1.9 Ω **Voltage Drop (mV's):** 1.0
- **Resistance [c]:** 1.9 Ω **Resistance Reversed:** 1.9 Ω

Grid Point Potential Readings Check – See Table Below

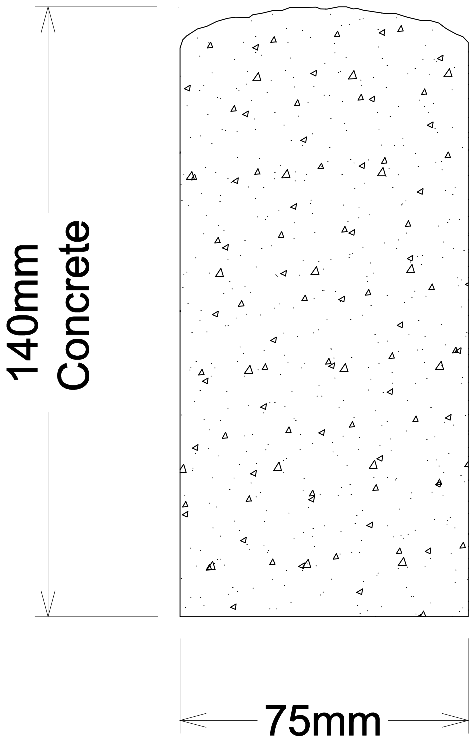
Location	Initial Reading	Check Reading [a]	Check Reading – Latex Concrete Overlay [b]
@ north	-0.224	-0.222	-
@ north	-0.236	-0.236	-
@ north	-0.230	-0.230	-
@ north	-0.143	-0.143	-
@ north	-0.125	-0.124	-

[a] Check at least five readings at beginning of test and each change in ground.
[b] On decks with latex modified concrete overlay, check at least five locations by drilling holes through the latex concrete overlay into the original concrete substrate.
[c] Resistance is the net resistance after deducting the lead resistance.

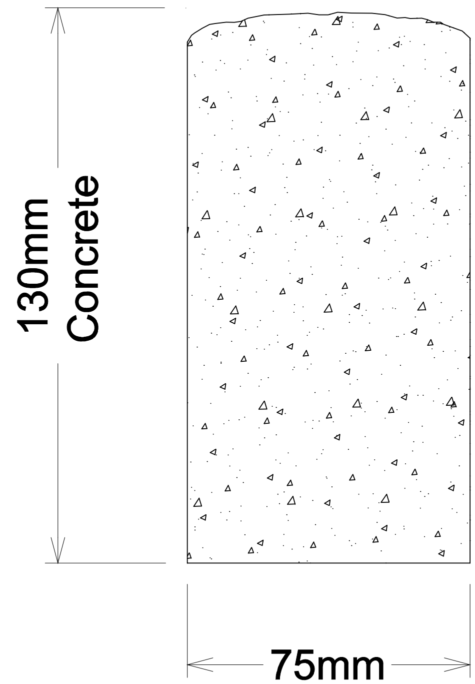
Appendix C:

Core Photographs and Sketches

Core C1

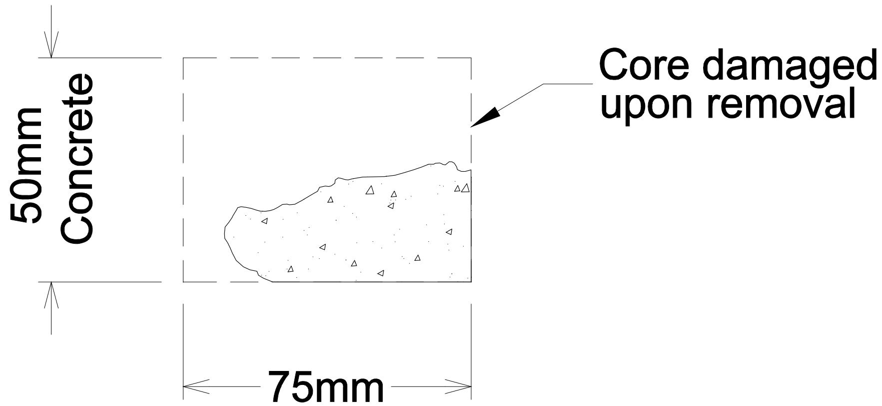


Core C2

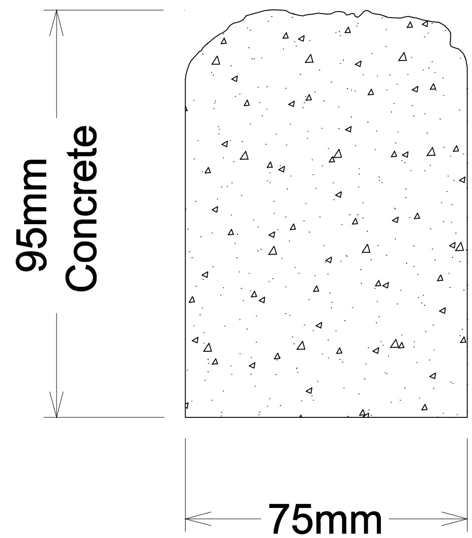


Core C3


Milwaukee
26ft
8m

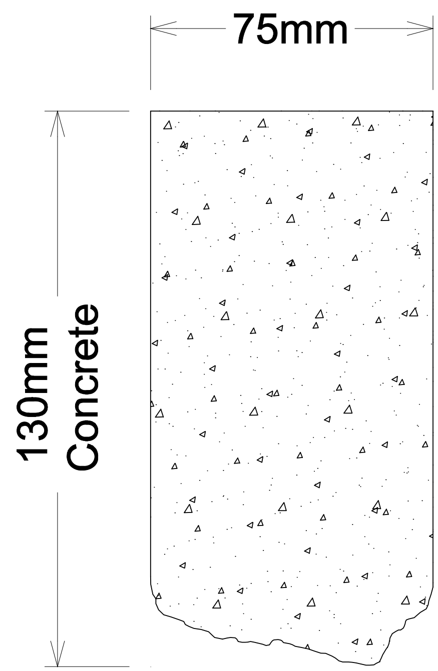

50mm
Concrete
Core damaged
upon removal
75mm

Core C4

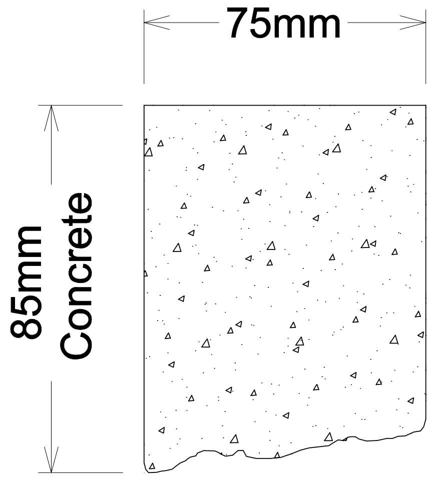


BRIDGE CHECK CANADA Ltd.
Your Bridge and Concrete Inspection Specialists

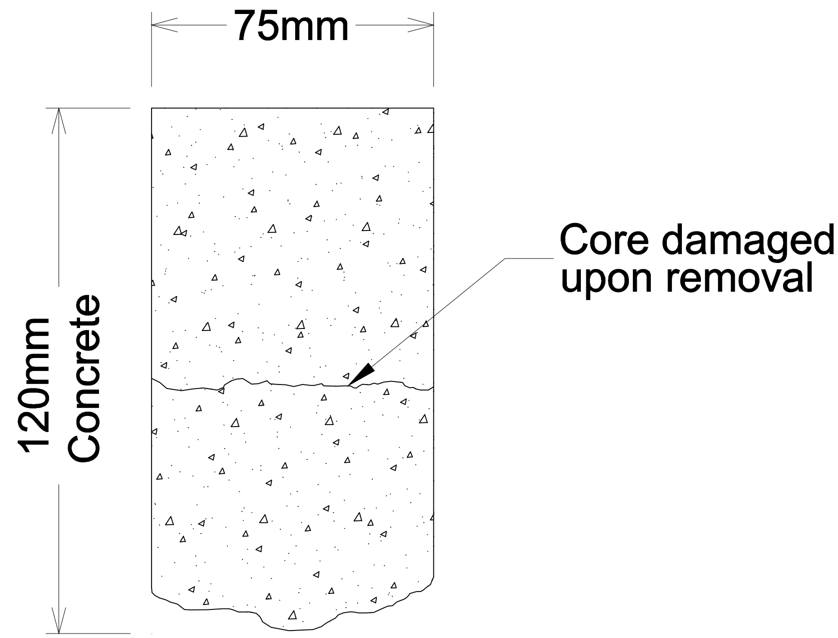
Core C5



Core C6



Core C7



Appendix D:

Core Logs

CORE LOG FOR EXPOSED CONCRETE

Site: Machinery Room

Core No.		C1		C2		C3	
Location (between gridlines)		Machinery Room Slab Soffit		Machinery Room Slab Soffit		Machinery Room Slab Soffit	
Diameter, mm		75.0		75.0		75.0	
Length, mm		140.0		130.0		50.0	
Full Depth (yes/no)		Yes		Yes		No	
Defects in Concrete (1)		-		-		-	
Condition of Rebar (2)		N/A		N/A		N/A	
Corrosion Potential		-0.121		-0.175		-0.131	
Compressive Strength, MPa		19.5					
Chloride Content % Chloride by Weight of Concrete		Total	Corrected	Total	Corrected	Total	Corrected
	0-10 mm			0.039	0.033		
	20-30 mm			0.029	0.023		
	40-50 mm			0.024	0.018		
	60-70 mm			0.026	0.020		
	80-90 mm			0.020	0.014		
	100-110 mm			0.020	0.014		
	120-130 mm			0.006	0.000		
AIR VOIDS	Air Content,%						
	Spec. Surf.,mm^2/mm^3						
	Spacing Factor, mm						
TEST LABORATORY		BCC		BCC			
REMARKS - orientation of rebars and cover - presence of overlay, patch and thickness - other observed defects						Core damage upon removal.	

CORE LOG FOR EXPOSED CONCRETE

Site: Machinery Room

Core No.		C4		C5		C6	
Location (between gridlines)		Machinery Room Slab Soffit		Machinery Room Slab (topside)		Machinery Room Slab (topside)	
Diameter, mm		75.0		75.0		75.0	
Length, mm		95.0		130.0		85.0	
Full Depth (yes/no)		No		No		No	
Defects in Concrete (1)		-		-		-	
Condition of Rebar (2)		N/A		N/A		N/A	
Corrosion Potential		-0.115					
Compressive Strength, MPa							
Chloride Content % Chloride by Weight of Concrete	0-10 mm 20-30 mm 40-50 mm 60-70 mm 80-90 mm	Total	Corrected	Total	Corrected	Total	Corrected
AIR VOIDS	Air Content,% Spec. Surf.,mm^2/mm^3 Spacing Factor, mm						
TEST LABORATORY							
REMARKS - orientation of rebars and cover - presence of overlay, patch and thickness - other observed defects							

1. Defects - C = Cracked, D = Delamination, R = Rough, Sc = Scaling, S = Spalling
2. Condition Rebar - G = Good, LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed
   Condition of Epoxy Coating – ECG = Good, ECF = Fair, ECP = Poor-rusted & debonded areas

CORE LOG FOR EXPOSED CONCRETE

Site: **Machinery Room**

Core No.		**C7**			
Location (between gridlines)		Machinery Room Slab (topside)			
Diameter, mm		75.0			
Length, mm		120.0			
Full Depth (yes/no)		No			
Defects in Concrete (1)		-			
Condition of Rebar (2)		N/A			
Corrosion Potential					
Compressive Strength, MPa					
Chloride Content % Chloride by Weight of Concrete		Total	Corrected		
	0-10 mm	0.014	0.008		
	20-30 mm	0.009	0.003		
	40-50 mm	0.025	0.019		
	60-70 mm	0.023	0.017		
	80-90 mm	0.016	0.010		
	100-110 mm	0.016	0.010		
AIR VOIDS	**Air Content,%**				
	Spec. Surf.,mm^2/mm^3				
	Spacing Factor, mm				
TEST LABORATORY		BCC			
REMARKS **- orientation of rebars and cover** **- presence of overlay, patch and thickness** **- other observed defects**		Core damage upon removal.			

1. Defects - C = Cracked, D = Delamination, R = Rough, Sc = Scaling, S = Spalling
2. Condition Rebar - G = Good, LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed
   Condition of Epoxy Coating – ECG = Good, ECF = Fair, ECP = Poor-rusted & debonded areas

Appendix E:

Site Photographs

Photo P1 **LaSalle Causeway Bascule Bridge, General View**

Photo P2 **Machinery Room Slab Soffit** (fair condition – cracks, spall, delamination, light scaling and honeycombing)

Photo P3 **Machinery Room Slab Soffit Deterioration** (cracks, spall and delamination) note exposed corroded rebar

Photo P4 **Machinery Room Slab Soffit Deterioration** (delaminations)

Photo P5 **Machinery Room Slab Soffit Deterioration** (spall and delamination)

Photo P6 **Machinery Room Slab Soffit Deterioration** (cracks, spalls and delaminations) note exposed corroded rebar

Photo P7 **Soffit at Machinery Room** (delamination and honeycombing)

Photo P8 **Machinery Room Slab Soffit Deterioration** (cracks, delamination and honeycombing)

Photo P9 **Machinery Room Slab Soffit Deterioration** (cracks, delamination and light scaling)

Photo P10 **Machinery Room Slab Soffit Deterioration** (medium scaling)

Photo P11 Machinery Room Slab Soffit Deterioration (medium scaling)

Photo P12 Machinery Room Slab Soffit Deterioration (cracks, spall and delamination)

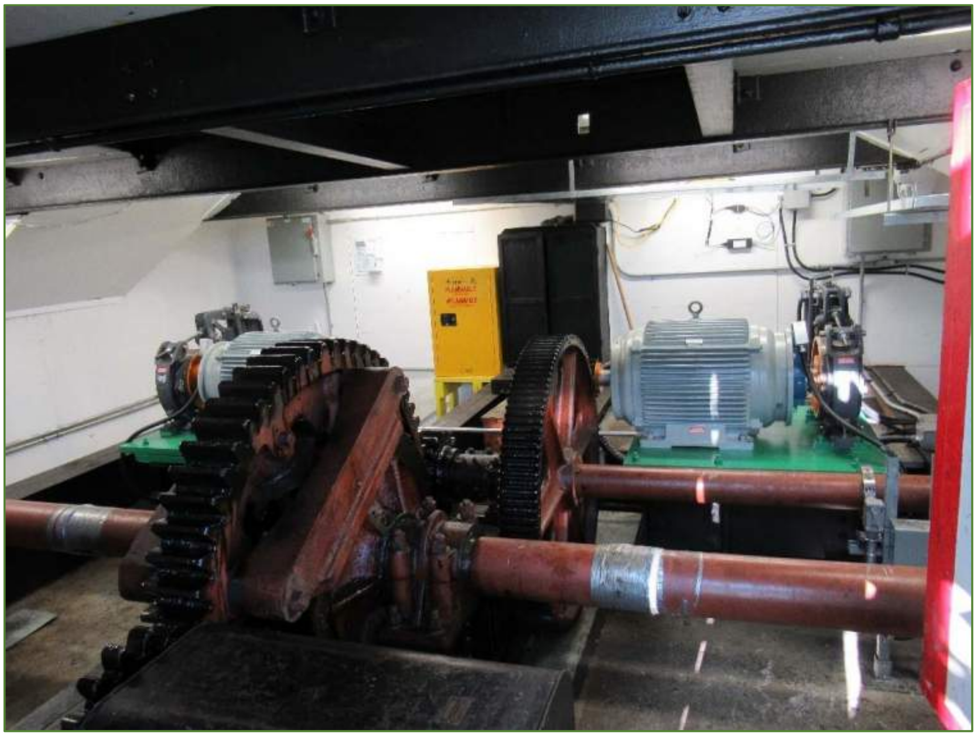


Photo P13 Machinery Room Slab, general view

Photo P14 Machinery Room Slab (topside)

Photo P15 Machinery Room Slab (topside)

Photo P16 Machinery Room Slab (topside) note light corrosion on steel components

Photo P17 Typical Condition of Inside Core C1

Photo P18 Typical Condition of Inside Core C2

Photo P19 Typical Condition of Inside Core C5

Photo P20 Typical Condition of Inside Core C6

Appendix F:

Laboratory Test Results

TOTAL CHLORIDE ION CONTENT

(Testing Method: MTO LS-417)

Project No.:	BCC19051
Site No.:	LaSalle Causeway Bascule Bridge
Location:	Machinery Room Slab, Kingston, ON

Core ID	Lab No.	Horizon from the Top of the Core (mm)	Chloride Ion Content (%)	Chloride Ion Content Corrected for Background* (%)
C2 (soffit)	L19-0786	0-10 (from soffit)	0.039	0.033
		20-30 (from soffit)	0.029	0.023
		40-50 (from soffit)	0.024	0.018
		60-70 (from soffit)	0.026	0.020
		80-90 (from soffit)	0.020	0.014
		100-110 (from soffit)	0.020	0.014
		120-130 (from soffit)	0.006	0.000
C7 (slab topside)	L19-0787	0-10	0.014	0.008
		20-30	0.009	0.003
		40-50	0.025	0.019
		60-70	0.023	0.017
		80-90	0.016	0.010
		100-110	0.016	0.010

*****Background chloride = 0.006%*
******The threshold of chloride ion generally regarded to be able to initiate reinforcing bar corrosion is 0.025%.*

Tested By: Shervin M
Date Tested: Sept. 3, 2019

____
Savio DeSouza, M.A.Sc., P.Eng.
Senior Principal Engineer

COMPRESSIVE STRENGTH OF CONCRETE CORES
(CSA A23.2-14C)

Project No.:	BCC19051
Site No.:	LaSalle Causeway Bascule Bridge
Location:	*Machinery Room Slab, Kingston, ON*

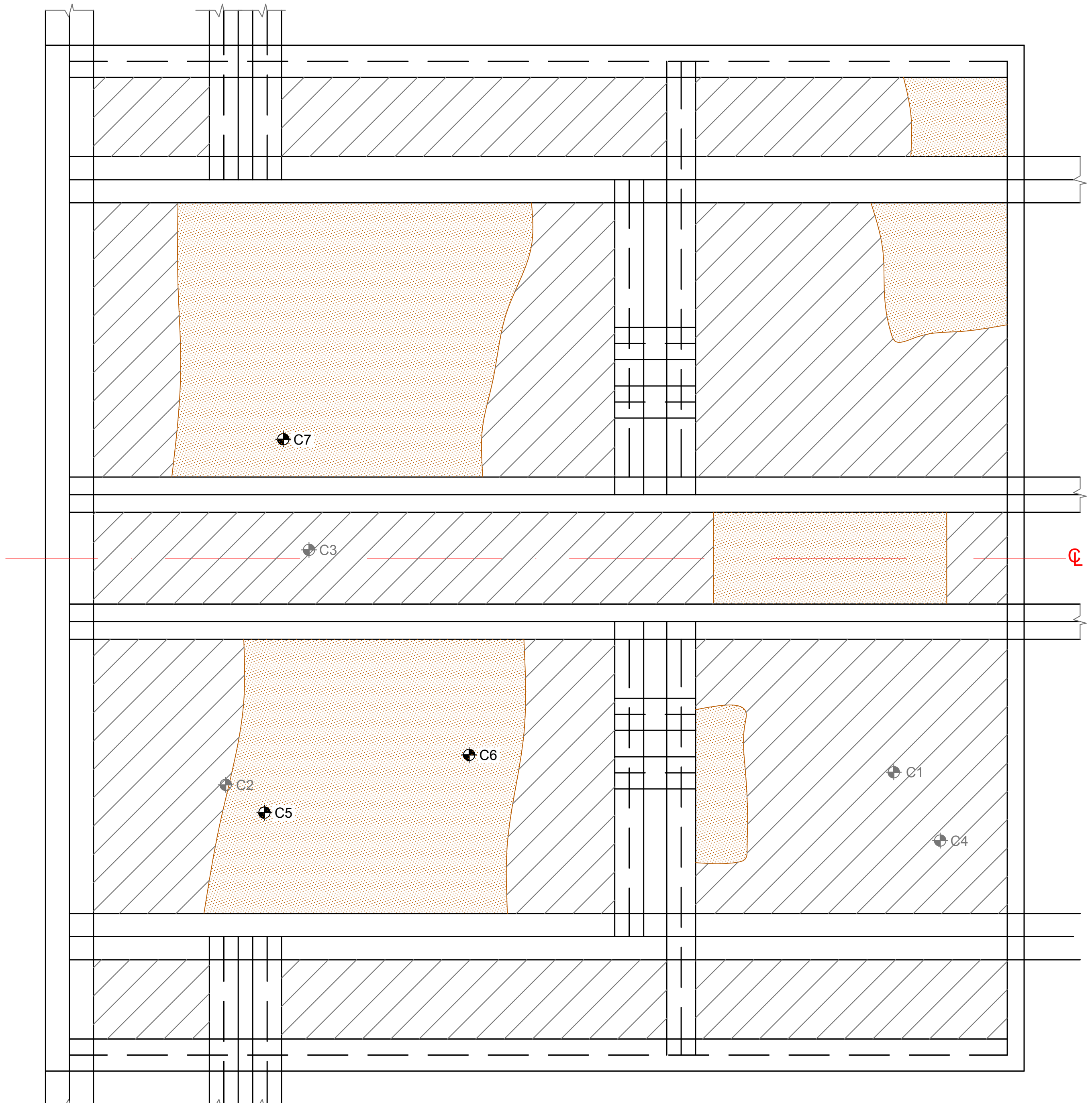
Core ID	C1
Location	Machinery Room Slab (soffit)
Lab No.	L19-0785
Date Cast	-
Date Cored	Aug. 15, 2019
Date Tested	Sept. 11, 2019
Capped Height (mm)	120.0
Average Diameter (mm)	75.0
Density (kg/m^3)	2289
Corrected Compressive Strength (MPa)	19.5
*** Direction of Loading**	Same as
Moisture Content at Time of Test	Moist
Remarks	

*Relative to the direction of original placement.

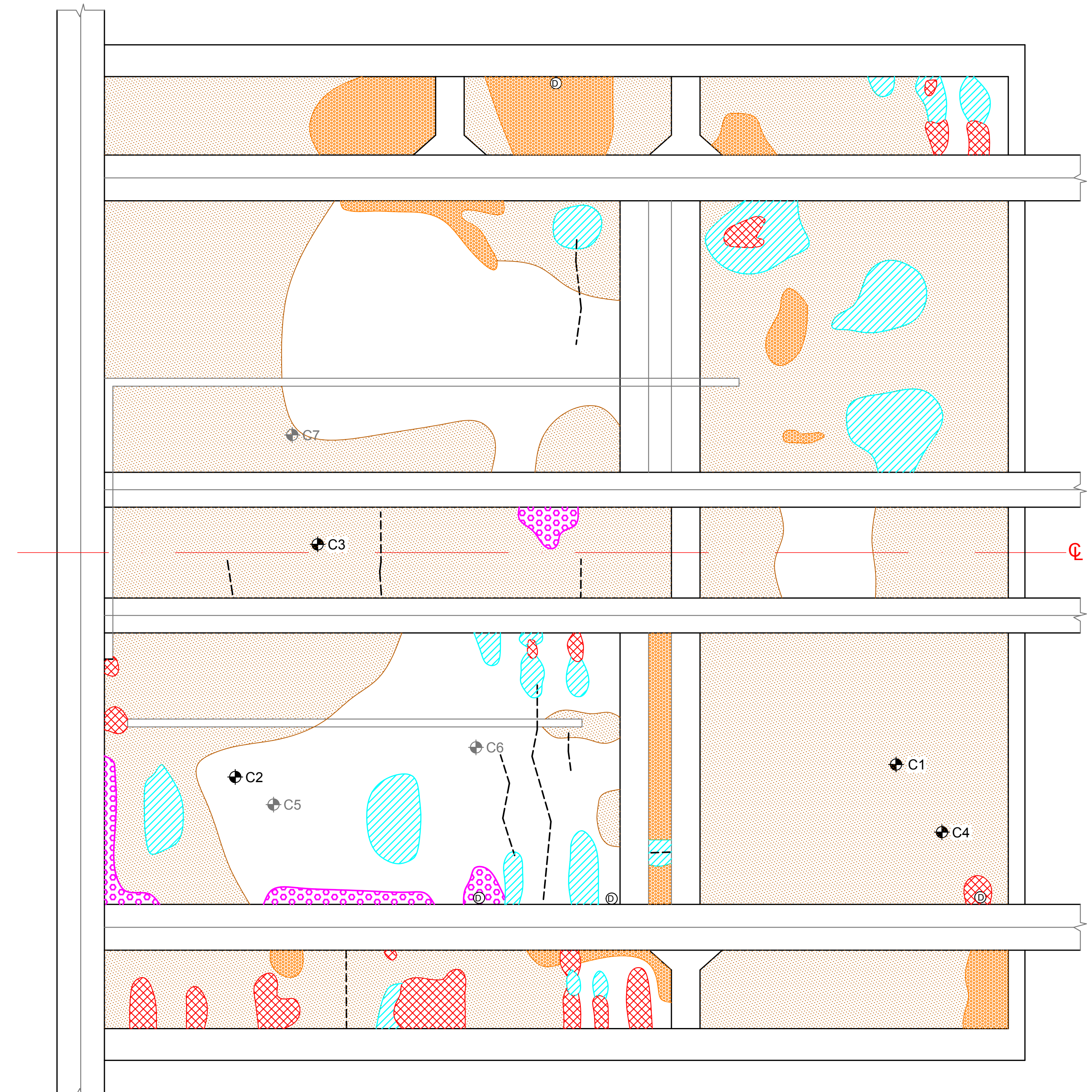
Savio DeSouza, M.A.Sc., P.Eng.
Senior Principal Engineer

Appendix G:

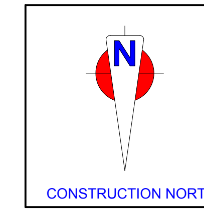
ACAD Drawings



SLAB (TOP SIDE) - INSIDE MACHINERY ROOM



SLAB SOFFIT (UNDER SIDE)



LEGEND:

- Drain
- C1 Core Sample Location
- Patched Spalls
- Delaminations
- Spalls
- Light Scaling
- Medium Scaling
- Severe Scaling
- Honeycombed Areas
- Wet Areas
- Concrete Pattern cracks
- Inaccessible
- Medium Concrete Cracks
- W Wide Concrete Cracks
- Medium Stained/ Efflorescence Cracks

BRIDGE CHECK CANADA

200 Viceroy Road, Unit 4
Vaughan, ON L4K 3N8
T: 905-660-6608 F: 905-660-6609

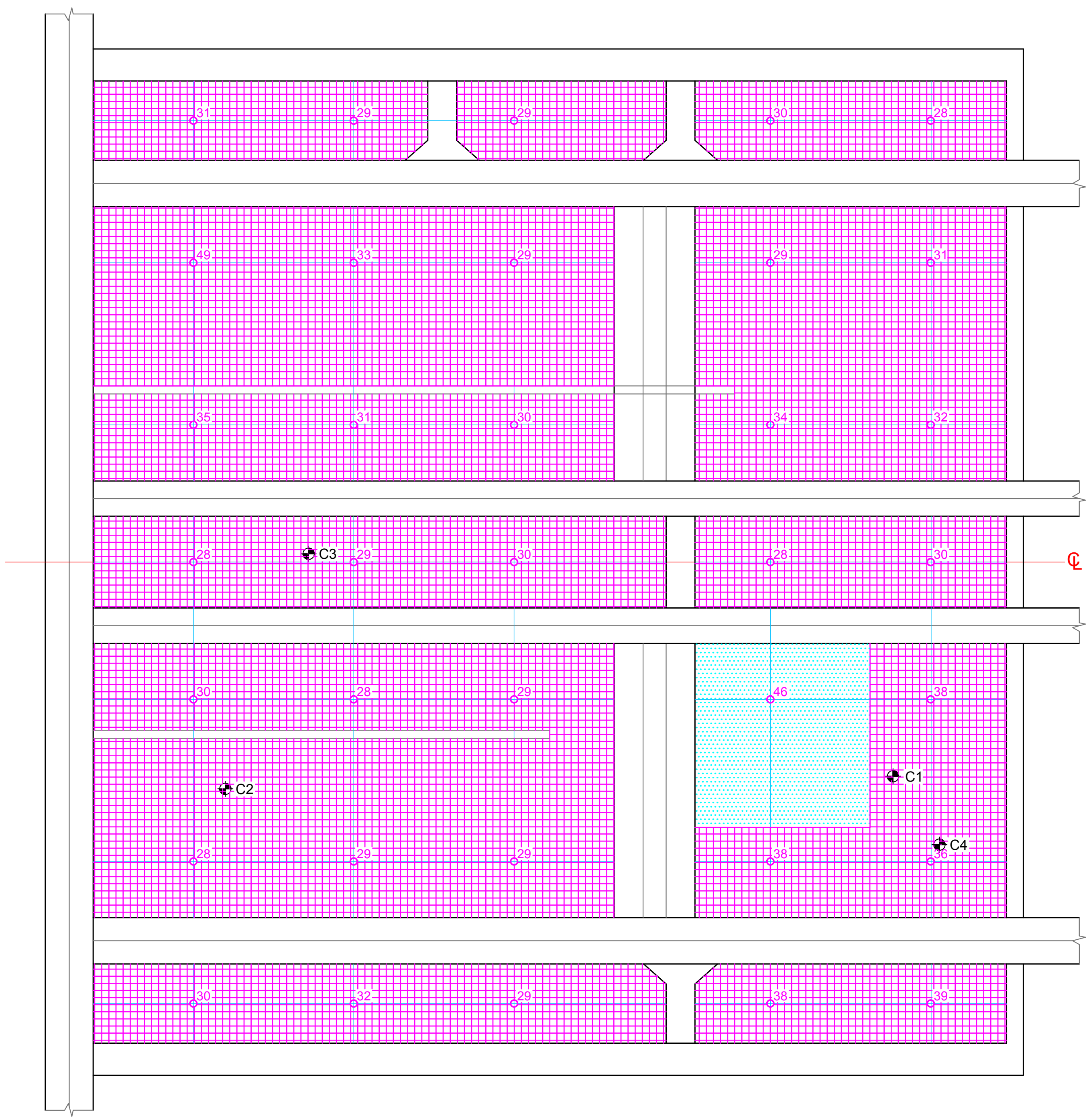
PROJECT:

LaSalle Causeway Bascule Bridge
Concrete Slab for Machinery Room
Kingston, ON

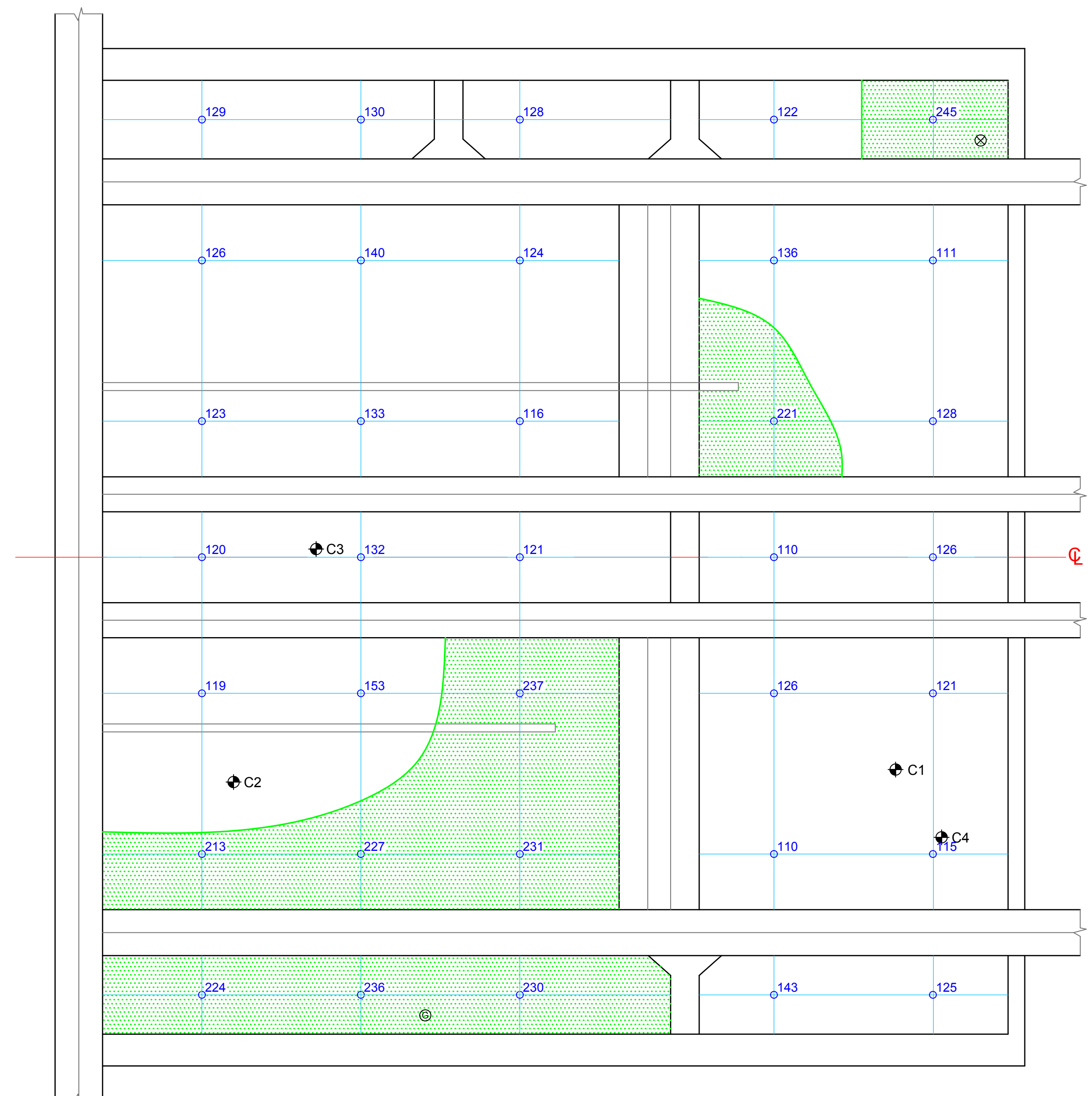
TITLE:

SURFACE DETERIORATION OF MACHINERY ROOM SLAB

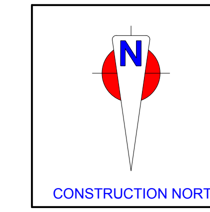
Drawing No.:	1
Project No.:	BCC19051
Date:	September 2019
Scale:	1:40
Drawn by:	JL
Checked by:	MA



SLAB SOFFIT (UNDER SIDE)



SLAB SOFFIT (UNDER SIDE)



LEGEND:

- Drain
- C1 Core Sample Location
- 80 Concrete cover-mm
- Cover over 60mm
- Cover from 40mm to 60mm
- Cover from 20mm to 39mm
- Cover less than 20mm
- -0.200 to -0.299 volts
- -0.300 to -0.349 volts
- -0.350 to -0.449 volts
- more negative than -0.450 volts
- Ground Location
- Ground Check Location
- 460 Copper-Copper Sulphate Half-Cell Potential (negative volts $x10^{-3}$)

BRIDGE CHECK CANADA

200 Viceroy Road, Unit 4
Vaughan, ON L4K 3N8
T: 905-660-6608 F: 905-660-6609

PROJECT:
LaSalle Causeway Bascule Bridge
Concrete Slab for Machinery Room
Kingston, ON

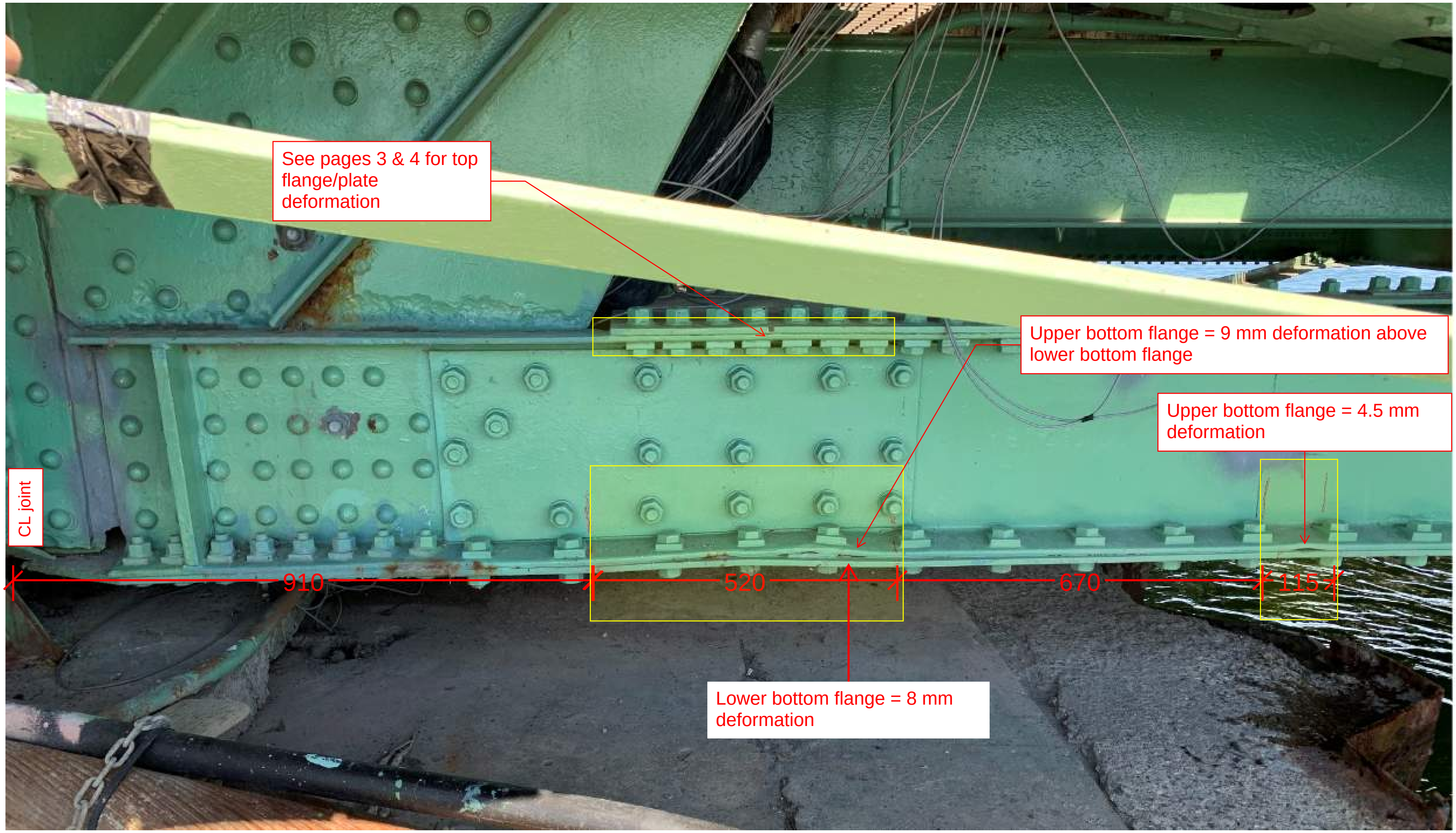
TITLE:
CONCRETE COVER AND CORROSION POTENTIAL OF MACHINERY ROOM SLAB

Drawing No.:	2
Project No.:	BCC19051
Date:	September 2019
Scale:	1:40
Drawn by:	JL
Checked by:	MA

APPENDIX J – BOTTOM CHORD 14S-16S DEFORMATION BASELINE MEASUREMENTS

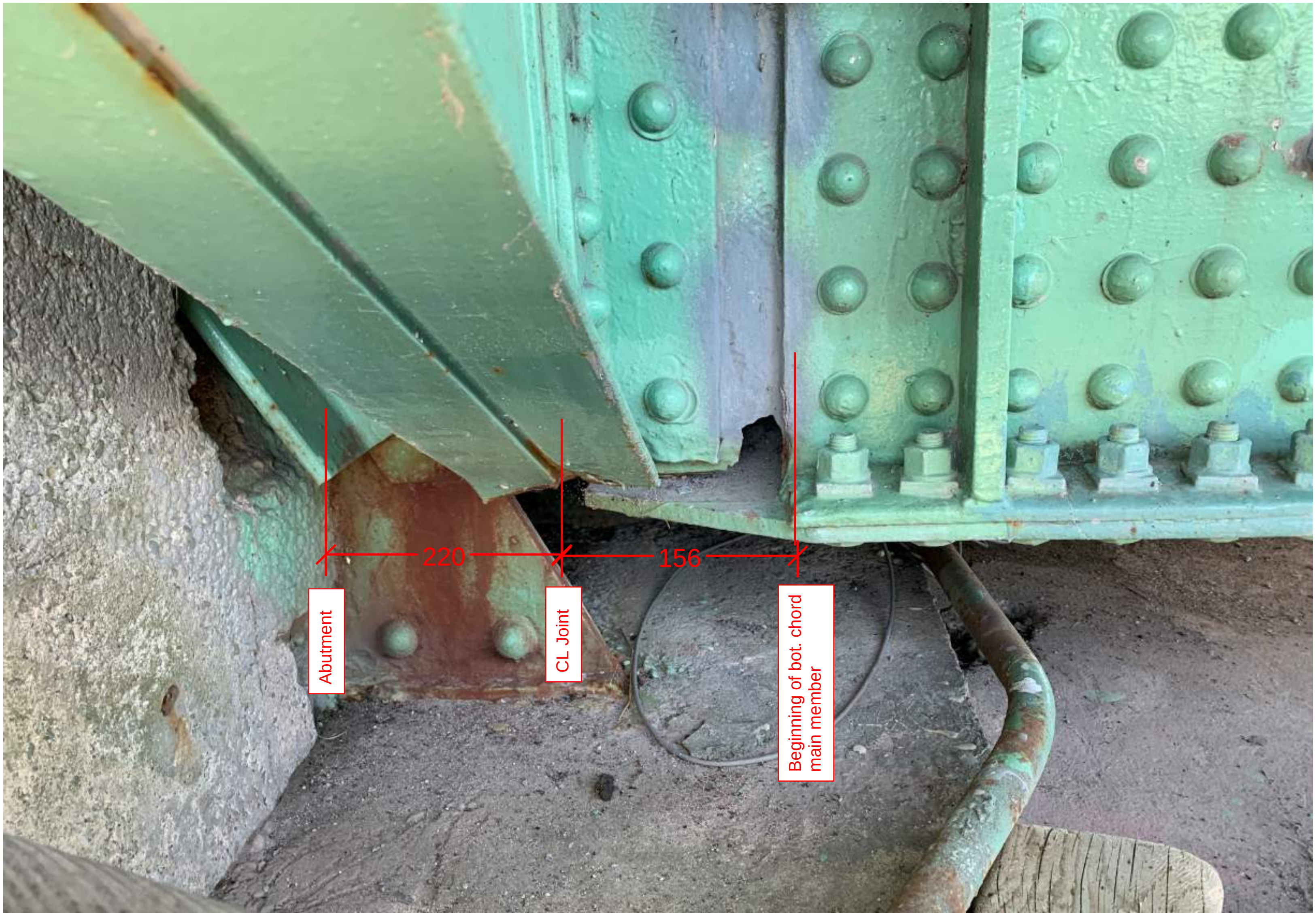
LaSalle Causeway Bascule Bridge
Bottom Chord 14S-16S Deformation - Baseline Measurements

Overall View



Measurements taken by Dennis Voltchek on May 20, 2020.

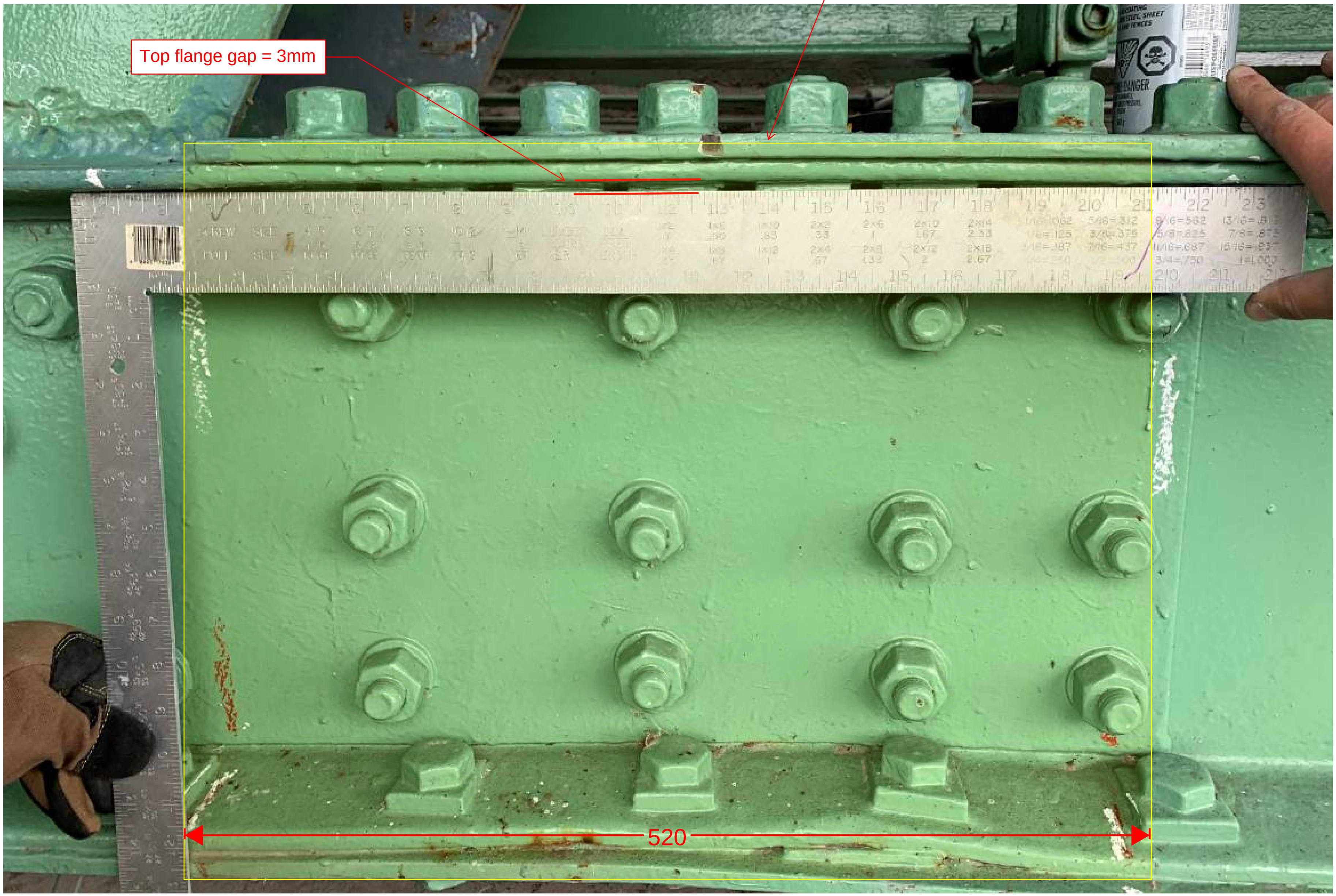
Beginning of Bottom Chord at West Abutment



Measurements taken by Dennis Voltchek on May 20, 2020.

Top Flange Deformation

Note that the lengths of deformation for the bottom and top flanges are approximately equal at 520 mm, as illustrated by the highlighted rectangle.



Measurements taken by Dennis Voltchek & Spencer Willows on May 28, 2020.

Top Connection Plate Deformation

Measurements taken by Dennis Voltchek & Spencer Willows on May 28, 2020.

Bottom Flange Deformation

Measurements taken by Dennis Voltchek on May 20, 2020.

APPENDIX K – NON-DESTRUCTIVE TESTING REPORT

Brouco NDT Inc.	**Welding Inspection Report** Form 201 Revision: 000 June 6 2011

Customer:	**Parsons Inc**	**Job No:**	**B-NDT-8370**	**Date:**	**August 19, 2019**
Project:	**LaSalle Causeway-Bascule Bridge Fatigue Evaluation/ 2019 Inspections**		**Weather Conditions:**	**25°C Sunny**	
Subject:	**Visual, Magnetic Particle Testing**		**Inspection Date:**	**August 14/15, 2019**	
References:	**CSA W 47.1 Standard, CSA W59-18 Standard, CSA W178.1, CSA W178.2, CGSB78.9712, ASTM E1444/ E1444M-16e1 Standard Practice for Magnetic Particle Testing, PSPC LC2018 Fatigue Inspection Plan**				

As requested by Peter Harvey and Brian Wood from Parson INC., inspector David Harper from Brouco NDT performed visual inspection and magnetic particle testing of the locations pointed out by Parson INC.

Equipment:

Parker Contour Probe Model DA400, Serial Number 19279, 6 Amp
Milwaukee Battery Powered Grinder (wire wheel and flap dick attachments used for surface preparation), 3000W Gas Powered Generator

Results:

1. Results of Magnetic Particle Testing as per member locations identified in the scope of work as well as any other locations identified for testing by the structural engineer in charge of the fatigue inspection and evaluation:

   a) Main Truss Chord Member 3S-5S: On previous report B-NDT-2865-1-oo a suspected lamination revealed a 60mm crack. This crack has increased in size to 80mm **(Figure 1)** and now is branching off to the other side 50mm **(Figure2)**. There was also a crack found on the bottom 50mm in length and a 3mm crack starting to come up off of the bottom into the vertical face **(Figure 3&4)**.

   b) Main Truss Chord Member 1S-3S: As requested MT testing on suspected lamination was conducted: This revealed a 41mm crack on the one side and a 30mm crack on the other side with a 3mm crack starting to propagate off of the 30mm crack **(Figure 5&6)**.

   c) Main Bottom Chord Gusset 13N-14N: As requested MT testing was conducted on a potential crack. No crack was revealed at the time of inspection.

d) Main Truss Vertical 9S-10S: On previous report B-NDT-2865-1-uu crack like indication was detected (3mm length) at weld location. This remains the same as previous report (**Figure 7)**

e) Main Truss Vertical 13S-14S: On previous report B-NDT-2865-1-qq No fatigue crack was found; however, this location should be monitored because the sharp orientation of the flame cut hole has the potential to develop into a fatigue crack. No change was detected **(Figure 8)**.

f) Main Truss Diagonal 13N-16N: On previous report B-NDT-2865-1-mm A 3mm crack was initially found. After grinding the crack was successfully removed. There has been no change since the previous report.

g) Main Truss Diagonal 8S-9S: On previous report B-NDT-2865-1-pp MT was performed at weld removal locations. No fatigue cracks found. This has not changed.

h) Counterweight Truss Bottom Chord 21N-27N: On previous report B-NDT-2865-1-ww MT performed at flange location where paint was cracking. MT confirmed a fatigue crack the full width of the bottom angle flange (potentially into the radius). The indication was very strong signaling a potential full wall thickness crack. There has been no change on this since the last report **(Figure 9).**

i) Tower Truss 18S-19S: On previous report B-NDT-2865-ss MT performed at section loss. Perforation/hole found with a fatigue crack propagation. Total length 60mm. This has increased to 3 holes and a total length of 70mm **(Figure10 and 11)**.

j) Tower Truss 18S-15S: As requested a MT inspection was completed on this section. The previous report called out a perforation/hole with a 3mm crack propagation of 3mm. This has increased to 2 cracks at 3mm in length **(Figure 12).**

Brouco NDT Inc.	**Welding Inspection Report** Form 201 Revision: 000 June 6 2011

Figure 1: 80mm Crack Identified (Previously Reported as 60mm)

Figure 2: Crack Extended 50mm on Other Side

Figure 3: 50mm Crack Located on the Bottom

Figure 4: 3mm Crack Branching off of the Bottom

Figure 5: 41mm Crack Detected

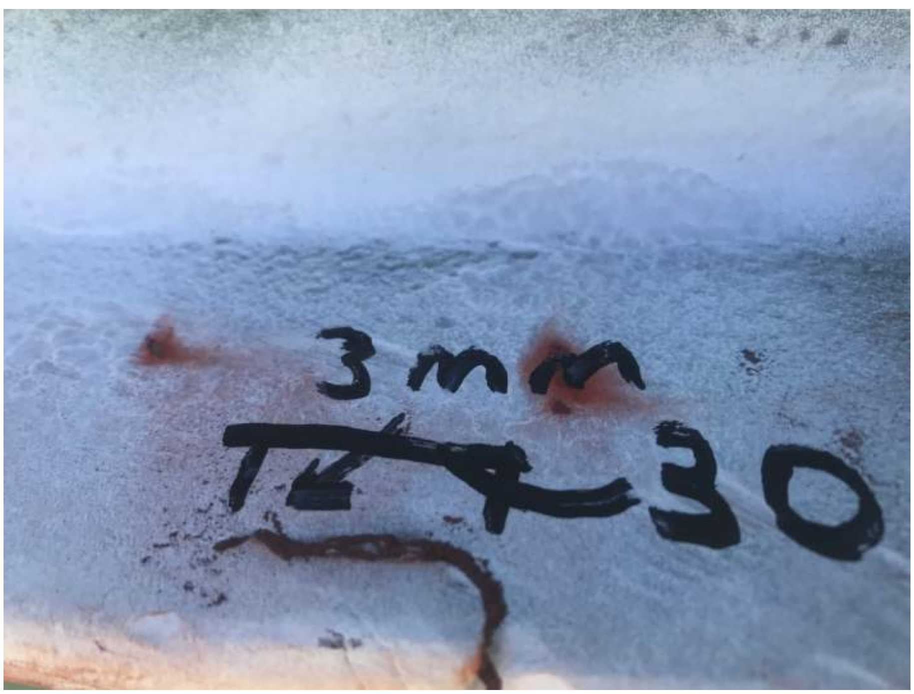


Figure 6: 30mm Crack With a 3mm Crack Coming from It

Figure 7: 3mm Crack no Change from Previous Inspection

Figure 8: No Change from Previous Inspection

Figure 9: No Change in Crack Length from Previous Report

Figure 10: Crack Prorogating from Holes

Figure 11: Showing Length

Figure 12: 3mm Cracks Forming on Both Sides

Conclusion:

The results of the magnetic particle inspection are documented in the above results.

Inspection Date: August 14, 2019 August 15, 2019 **Report Date**: August 19, 2019	**Inspection and Report by**: David Harper CSA W178.2 Level 2 Certified Welding Inspector Reg. #5338 **Report Reviewed by**: Kent Leclair CSA W178.2 Level 3 Certified Welding Inspector Reg. #3938 Level II MT CGSB Reg. #16878

Lasalle Causeway Bascule Bridge

2019 Comprehensive Detailed Inspection Report

Spencer Willows, E.I.T.
1223 Michael Street North,
Suite 100
Ottawa, ON K1N 7X4
613.738-4160

Peter Harvey, P.Eng.
1223 Michael Street North,
Suite 100
Ottawa, ON K1N 7X4
613.738-4160

PARSONS

5875 Trinity Parkway, Suite 300
Centreville, Virginia 20120
Direct: +1 703.988.8500
parsons.com